AMERICAN MACHINIST

JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 13, No. 36. WEEKLY. | NEW YORK, THURSDAY, SEPTEMBER 4, 1890. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

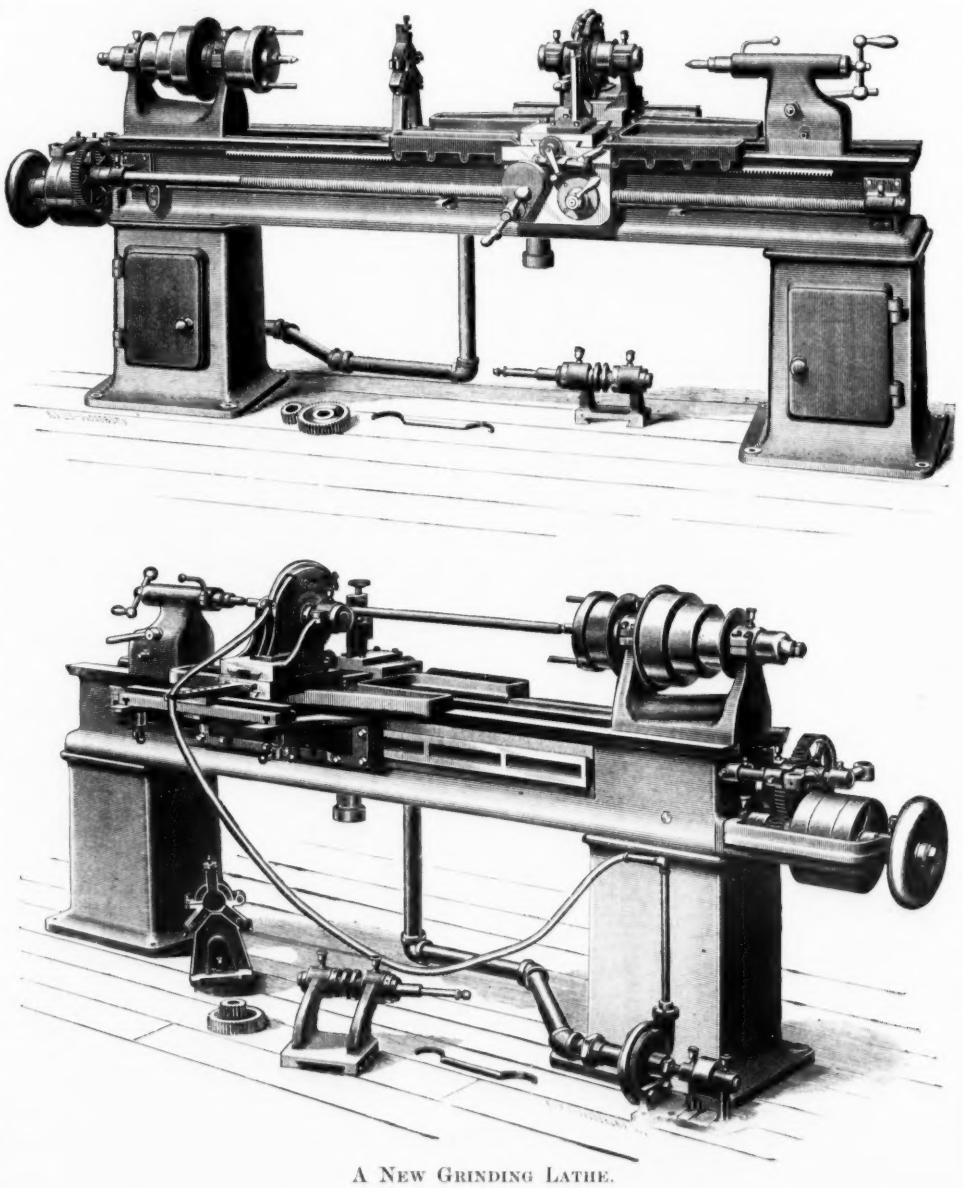
COPYRIGHT 1890, BY AMERICAN MACHINIST PUBLISHING COMPANY. **For Sale Everywhere by Newsdealers.** ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

A New Grinding Lathe.

On this page we give illustrations of a new machine for grinding cylindrical or conical surfaces. As will be seen, the machine is essentially a lathe with such modifications as are called for by the fact that its work is done by grinding instead of by a cutting tool. The top of the bed is flat, affording a large surface upon which the carriage moves, and the outer edges are cut under at an angle, the carriage being gibbed. Its bearing on the bed is long, and its upper surfaces are so formed as to make a receptacle for the water used in grinding, from whence it flows to the bed, which is closed at the bottom to form a trough for the double purpose of securing rigidity and to form a reservoir for water. The pump shown keeps the water in circulation, and supplies it abundantly to the wheel.

At the back of the bed is a regular Slate taper attachment, by which any ordinary taper can be ground in either outside or inside grinding, the former, of course, without the necessity for throwing the centers out of line. The carriage is moved by a screw, which is in front of the bed, working in a nut, which can be opened or closed upon it by a cam movement in the ordinary manner. This screw, instead of being driven by gears or belt from the spindle, as is the case in lathes, is driven by separate belts from the countershaft, one of which is open and the other crossed, working on tight and loose pulleys after the manner of a planer motion, the belts being shifted by movable stops to reverse the motion of the carriage automatically. Work may be revolved upon dead centers or otherwise as may be preferred, and any kind of chuck or face-plate may be substituted for the whirl, the same as on a lathe.

A follow rest is provided, which comes in front of the wheel, and there is also a separate head which can be put on for inside grinding. Just back of the hand-crank on the cross-feed screw is a small worm-wheel with which can be connected a worm, which is supported in suitable bearings below so that it can be turned by a knurled disk. This worm can be connected or disconnected from the wheel at pleasure, and when brought up into action enables the cross-feed screw to be turned a very small amount with much greater certainty and accuracy than would otherwise be possible, and at the same time the wheel can be moved rapidly when required.



A NEW GRINDING LATHE.

The machine will swing over the carriage 15″ diameter, and will take in work 7 ft. long between centers. The emery wheels used are 1″x9″, and are mounted on a spindle 1¼″ diameter running in taper sleeve bearings provided with means of adjustment for wear.

The main bearing of the head-stock spindle is 2″x3¾″; cone pulley is for a 2½″ belt. Taper holes in the spindles are the No. 3 Morse taper. The countershaft is provided with a drum 16″ diameter for driving the emery wheels. The machine is made by the Springfield Emery Wheel Mfg. Co., Bridgeport, Conn.

The British Board of Trade.

In reading English papers an American reader cannot fail to have been struck by the frequent reference to the Board of Trade in regard to various matters of engineering. Few readers of the AMERICAN MACHINIST, probably, fully understand what the Board of Trade is, what are its functions, and whether, on the whole, its influence is for good. A short reference to these points will, we think, not be out of place.

The "Board of Trade" is a department of the government, the head offices of which are in Whitehall Gardens, London. The president of the board is a member of the government, with a seat in the cabinet. There are the usual permanent secretaries and other officials.

Generally the B. of T., as it is usually termed in England, takes charge of all matters relating to trade and commerce. For example, one of its duties is the determination of standards of weights and measures, a branch under the charge of Mr. H. I. Chaney, and in a list of assistant secretaries to different departments of the board is one to the Harbor Department, one to the Marine Department, and others to the Railway Department, Finance Department, Commercial Department and Comptroller of Corn Returns.

As regards engineers, the Marine and the Railway Departments will call more especially for remark.

The Marine Department exercises control over shipping in various ways. By its surveyors ships are inspected for seaworthiness and as regards their boilers and machinery, and before a ship can leave port it must be certified to by the B. of T. as fit in every repect. The board regulates the number of passengers allowed, the tonnage for cargo, etc., and inquires into cases of collision and wreck, and grants certificates to ships' officers in navigating, as well as to marine engineers. Probably the nearest approach to any similar body in the United States is the Board of Supervising Inspectors of Steam Vessels, which exercises the control which is vested in the Board of Trade of England.

The engineers of the board publish formulæ for the strength of boiler shells and furnace tubes, and on the whole have, perhaps, exercised a beneficial effect upon marine engineering, though it is questioned if they would have done so had it not been for the independent action of "Lloyds," a sort of marine classification of ships, which carries great authority, and is usually considered ahead of the red-tape officialism of the Board of Trade, which has followed in the wake of Lloyds on matters of scientific investigation, and so has not fallen so hopelessly in the rear as it would, no doubt, otherwise have done.

Since the passage of the Boiler Explosions act, the B. of T. has had added to its duties the investigation of every land boiler explosion in Great Britain and Ireland, other than boilers which come under the supervision of the inspectors of mines under the Home office. It has not proved itself specially satisfactory in this respect, its reports upon boiler explosions being held up to ridicule, as may well be the case when it classes as a boiler explosion the melting out of a fusible plug, and bearing evidence of being written by men having but little acquaintance with land boilers.

On the whole, perhaps, it is in the Railway Department where the Board of Trade exercises its chief control as regards engineering other than marine. It is by the control of the board that no British railway can be worked in a palpably unsafe condition. Such a thing as the running down of the road and rolling stock to a condition of absolute danger would be impossible A road thus run down, as we regret to say is often done on this side, would be promptly closed or traffic on it suspended; or, if moderately bad, passenger traffic would perhaps alone be ordered to be discontinued.

As an example of the control exercised, a recent order has been made compelling every line to be worked by the block system by November, 1890, the only exceptions allowed being with short branch lines, worked by *one* locomotive, or single tracks worked by the train staff system.

Bridges, of course, come under the board's supervision, and in this respect the board is responsible for the rule of an uniform stress of five tons per inch section in tension for wrought-iron—a rule which has kept back progress in British bridge building, and favored types of bridges where, five tons being too high for certain details and too low for others, a general mean has been struck by the use of rigid trusses acting as whole beams rather than as articulated structures. As an economy, the rule has perhaps been bad, but as a public safeguard it has been efficient, and the record of failures has been practically *nil*, that of the Tay Bridge being abnormal, and due to bad design of piers rather than to defects of superstructure.

In respect to the huge Forth Bridge, this was built under Board of Trade inspection, and the material in it was allowed a maximum stress of 7½ tons (of 2,240 pounds) as a concession to steel, and certain conditions laid down by the board, the usual maximum for steel being the low stress of six tons only.

After the Tay Bridge disaster a committee was appointed to consider the question of wind pressures, the report of the committee being rendered to the Board of Trade.

The board publish blue books on different subjects, one, for example, called the continuous brake return, giving the particulars of every railroad company's progress in fitting its rolling stock with continuous brakes. Other blue books give par-

ticulars of numbers of passengers carried by different roads, and a great variety of statistics of railway working.

Some recent tests have been carried out by the board's engineers upon the crushing strengths of boiler flues of corrugated plate and of Brown's ribbed plates, which are valuable. As regards the control over railroads, there is not much doubt but that the supervision of the Board of Trade has been a decided means of insuring the safety of the traveling public, though, indeed, were such control not exercised, it is very questionable if the public safety would be endangered by neglect of bridges and viaducts, as coroners' juries would promptly return verdicts of manslaughter against those responsible for such. Still, the control of the board has checked any attempts in the direction indicated, and speculation in railroad stocks has been, in consequence, of a very much milder description than that which flourishes in Wall street.

An officer of the board inquires into all cases of loss of life on the railroads, and reports to the board any defects in signal apparatus, track, locomotives and cars, or management, which may have led to the accident, and the board apportions censure accordingly. There is thus offered the curious spectacle of two separate and independent inquiries—one, that of the board upon the accident, whether resulting in loss of life or not, and when life is sacrificed, the ordinary coroner's inquest into the death or deaths. A coroner's jury may return a verdict out of harmony with the opinion expressed by the officials of the board, and perhaps find a case for trial of a signalman for manslaughter, or they may return practically a verdict acquitting a signalman of blame who has incurred censure from the board.

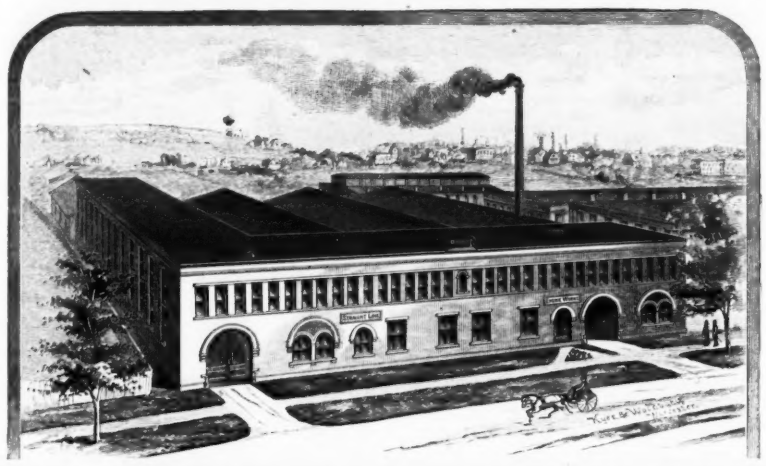
The reports on accidents by the board's officials are frequently very severely criticised, and do not, perhaps, carry much weight when they contravene public opinion, and though, as is usual with officialism the world over, the opinion of the board's engineers is, in many cases, so little valued, there nevertheless remains the immense safeguard consequent upon a full and searching inquiry such as railroad companies hate. Hence, the net result is good.

Of the more directly commercial functions of the Board of Trade is the preparation of statistics of imports and exports, and other statistics usually classed as the Board of Trade Returns.

The inspection of factories, mines, fisheries and explosives comes under the control of the Home office, not of the Board of Trade, but it will be seen that the duties of this latter are nevertheless already very numerous and varied, and such as to account for the frequent occurrence in the papers of the name of this department of the British Government.

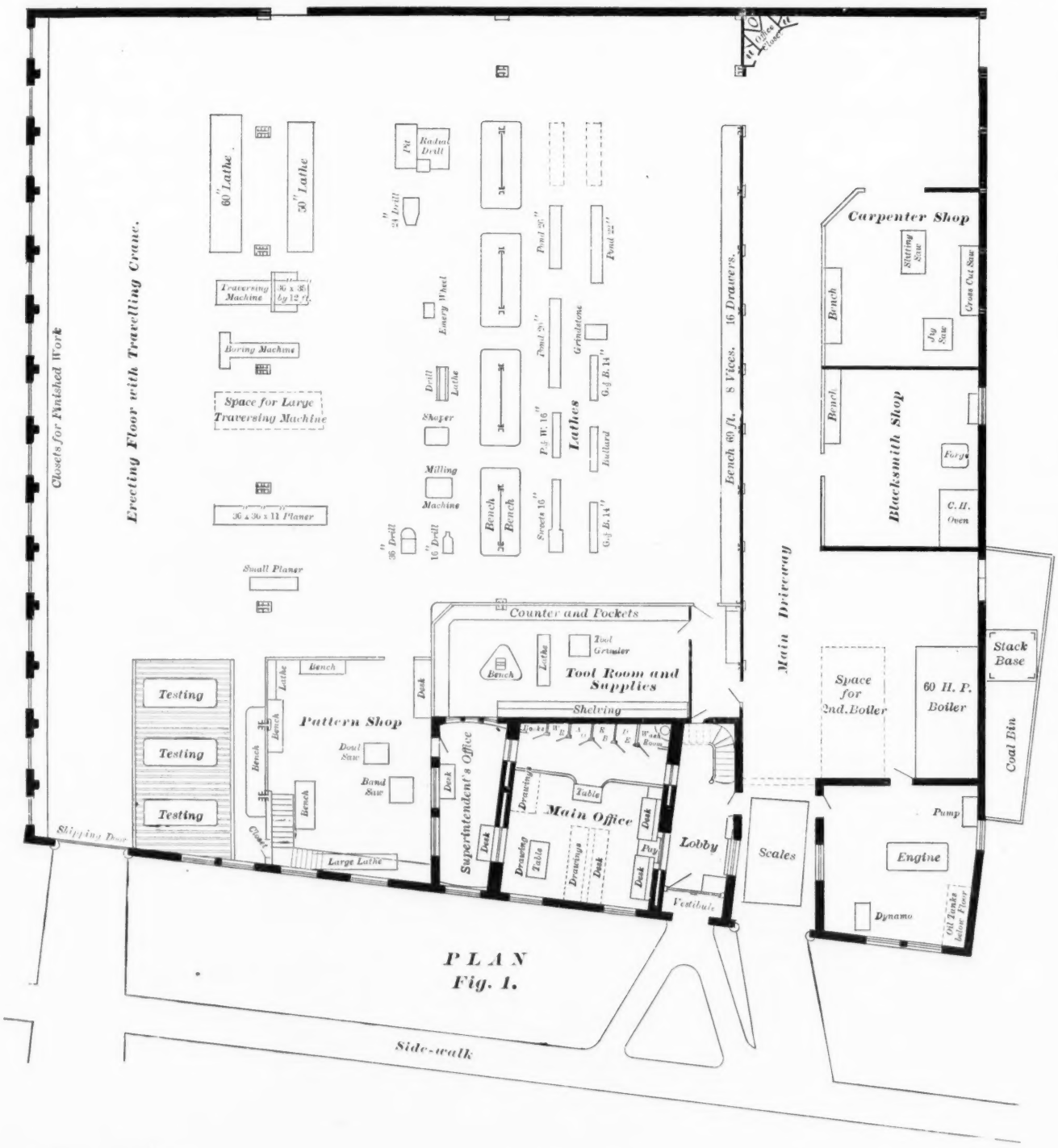
The New Works of the Straight Line Engine Company.

A visitor to the new shops of the Straight Line Engine Co., at Syracuse, is apt to find many things there which will surprise him somewhat, the first surprise which he encounters being the inscription which is carved in letters of stone over the main entrance: "Visitors always welcome." This differs radically from the usual notice nailed to the gateway of machine shops: "No admittance, except on business"; but it differs scarcely more than many of the features found inside the shops differ from those of other modern engineering establishments.



The view we give on this page has the appearance of a two-story building, but, as will be seen by the section, Fig. 2, the shop proper is one story only, the high section at the right furnishing room for the traveling crane, and the only portion that is really two stories is that occupied by the offices, the space above which serves as a space for storing pattern lumber, and the dining and reading-room, 20 by 40 feet, for the men, which also serves for stockholders' and other meetings.

Fig. 1 gives the ground plan arrangement. The front along the east, running at an angle, is partially disguised by the arrangement of the offices, beneath which there is a cistern, capable of storing all the water from the roof, in a 3-inch rain storm. The driveway, as will be seen, runs through the building, cutting off the engine-room, boiler-room, blacksmith and carpenter shops, separating them from the main shop as usual, except that they are all under the same roof.



PLAN
Fig. 1.

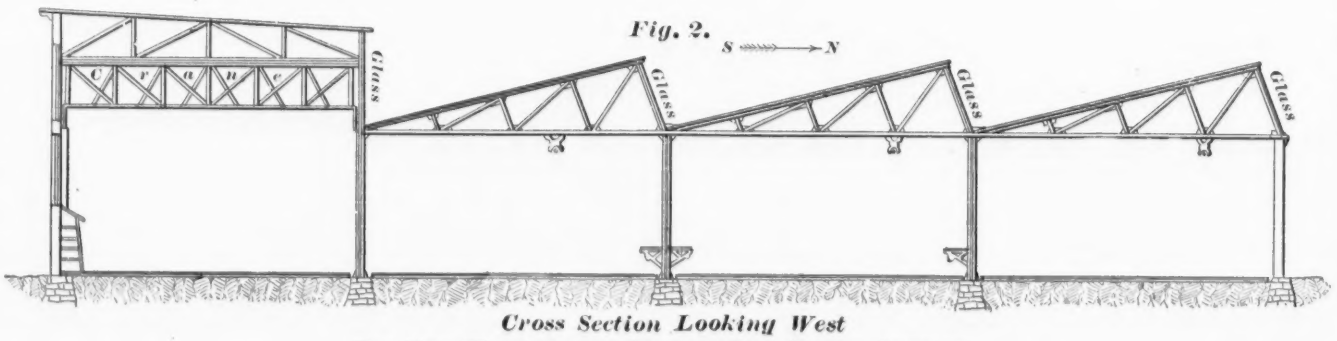


Fig. 2.

Cross Section Looking West

THE NEW WORKS OF THE STRAIGHT LINE ENGINE COMPANY.

The irregular shaped superintendent's room has windows on two sides, giving a full view of the machine-room, and is immediately adjoining the part railed off for the pattern makers.

The tool and store-room are in one, and it is designed to have machines for one tool maker, and benches for scraping valves.

The traveling crane reaches the larger tools, the testing and erecting floor, along the entire south side of which there is a line of closets for finished work, with panel doors.

A stairway in the pattern shop leads to the dining-room for the men.

The cross-section of building, Fig. 2, shows that the three north sections have roofs of the saw-teeth form, the north slopes being of glass, and these, with the double rows of windows on the south, gives one the impression on first entering that the ruling element of the whole establishment is light.

Throughout the entire structure it is evident that each detail has been a separate study. The floor is 2″ plank with an inch hemlock facing, planed and jointed without matching, laid upon two feet of stone work. The posts made of two channel irons, curved and united to a cast-iron base, as shown in Fig. 5.

The style of roof trusses is shown in section, Fig. 2, and by Fig. 6. The trusses are wholly composed of 2 ″x3¼″ angle iron, placed 8 feet from center to center, and carry the roof planking, which is the only wood about the roof, excepting a strip of ⅞″x3¼″ riveted between the angle iron which forms the rafter, and to this strip of wood the roof planks are nailed.

The outside window sash and framing—except in the offices—and all the thin partitions, are of iron. All the iron work is painted a light blue, and the wood work a light yellow.

The outside walls are of brick, excepting that on the west, which is covered outside and in with corrugated iron, removable, if any extension of the works should hereafter be decided upon.

In the arrangement of shafting, the engine drives the jack shaft at high speed, and from this the dynamo is to be driven, without an excessively large pulley.

The first line, running to carpenter shop, runs at 250 revolutions, and from this, belts drive the two lines in the machine shop at 150. Either of the three lines can be stopped without stopping the others; cords being arranged to operate clutches from the points most convenient, should occasion demand a quick stop. The line shaft hangers are of new design.

The work benches are bolted strips of maple plank, set edgewise, and the drawers, of cast-iron, are no drawers at all, but boxes of the same size as drawers, cast on an iron post, and swing out like a crane. The stack shown in Fig. 4, and the traveling crane, of which we may give cuts later, are both special designs.

All men, and some buildings, have their weak points.

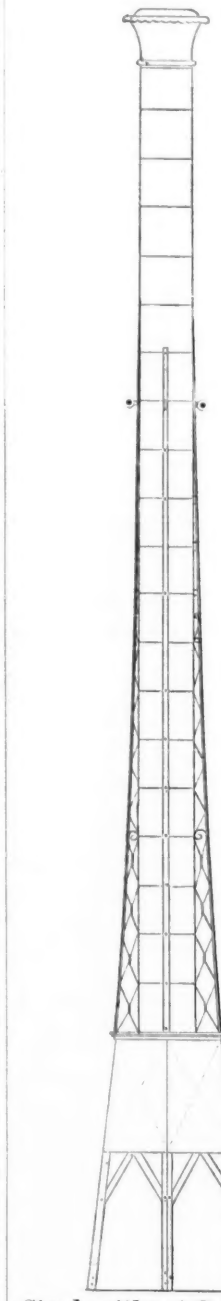
Mounting the engine over the central front naturally raises the question of good taste, and can be justified only on the ground that there seemed no better place to put it and get it out of the way, unless it was in the cupola; but as it was the original, for which the professor seemed to have a feeling of reverence, it was a question with him between good taste and affection, in which the latter won.

It is hoped to balance this possible defect by procuring a bust of James Watt, to place in the central niche.

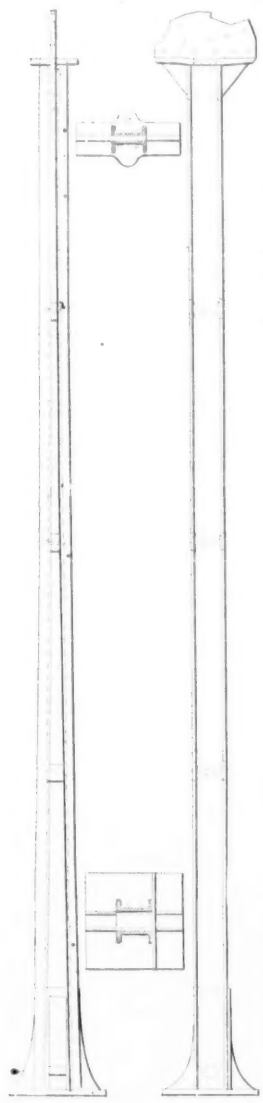
Such of our readers as have an hour or two at their disposal in Syracuse will find over the entrance of the works of the Straight Line Engine Co., the motto—"Visitors always welcome"—and the spirit of that motto acted upon within.

It will be remembered that some two years since the jute manufacturers formed a pool and raised enormously the price of jute bagging for wrapping cotton. The Farmers' Alliance took a hand in the deal, and a considerable part of the cotton crop of last year was wrapped in cotton bagging. This year the Alliance has decreed that the cotton wrap shall be used. This commendable action of the Alliance has broken up the Jute Trust and brought to grief those who proposed to get two or three prices for their product. It was a good work.

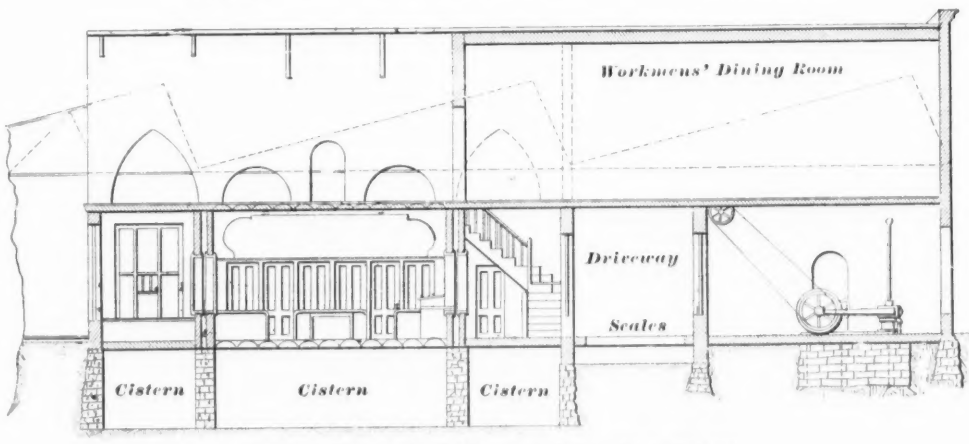
The Mombasa and Nyanha Railway was publicly inaugurated recently. Mombasa is one of the East African Company's most southern possessions, and this railway is the first to be built on the east coast. It will be five hundred miles in length, and will penetrate regions said to be rich in natural resources.



Stack without Guy Rods.
Fig. 4.



Channel Iron Post
Fig. 5.



Section through Office and Engine Room.
Fig. 3.

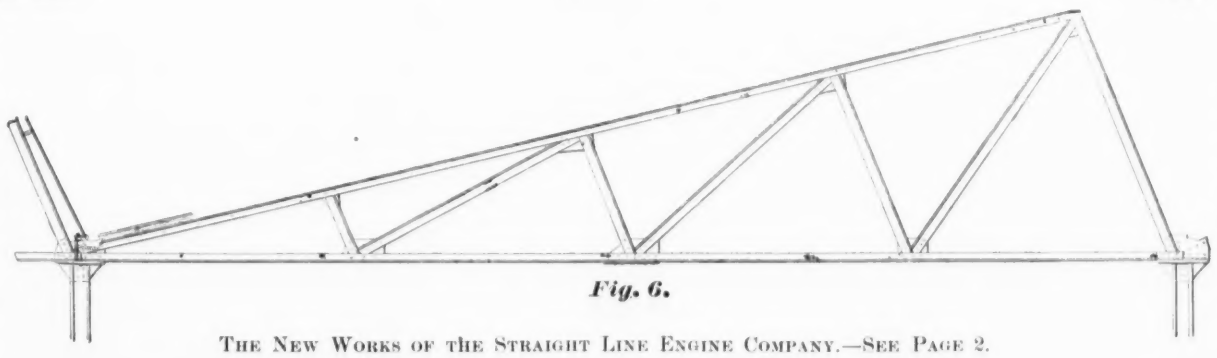


Fig. 6.

THE NEW WORKS OF THE STRAIGHT LINE ENGINE COMPANY.—SEE PAGE 2.

White Prints.

BY J. L. BIXBY, JR.

The receipt for making white prints can be found in several books and papers, but to make them successfully, even with the receipt, is quite another thing. If I am not greatly mistaken a receipt for them is given in *The Techno-Chemical Receipt Book*, in one issue of *La Nature*, *The Engineering News*, and some other papers that I do not remember the names of; but I am sure that I have seen no less than five receipts or copies of the same. In all shops where a regular line of work is done, blue prints are much preferable to white prints, as they are easier and cheaper to make, besides giving better satisfaction. White prints are adapted to special drawings, bridge and structural work, or any case where but one set of drawings will be required. They are better adapted to this class of work for the reason that corrections can be easily made on them, whereas with blue prints it is the reverse.

The chemicals required are as follows:—

A
- No. 1.—Granulated gum arabic.
- No. 2.—Tartaric acid.
- No. 3.—Sulphate of iron.
- No. 4.—Sesquiperchloride of iron.
- No. 5.—Gallic acid.

Dissolve and thoroughly mix

B
- 1 oz. No. 1 in 3 oz. of water.
- 1 oz. No. 2 in 3 oz. of water.
- 1 oz. No. 3 in 3 oz. of water.
- 2 oz. No. 4 in 3 oz. of water.

Put this last combination in separate bottles, giving each its respective number; that is, mark each bottle. The solution for preparing the paper is made from the last combination as follows:—

C
- 3 parts of No. 1.
- 2 parts of No. 2.
- 1 part of No. 3.
- 2½ parts of No. 4.

Add two or four parts of water; four parts for light, quick prints, two parts for dark ones. Better results will be attained if the water for numbers 1 and 5 is boiling hot, or even blood warm.

To prepare white prints is much more difficult than to perform the same operation for blue prints; that is, to prepare them so that they will not be streaked. It can be accomplished in the following manner: Get a large drawing-board, screw an eyelet in the center of one of the edges, and suspend it on the wall at a convenient height, having about a six-inch loop of string for a cord; this is done so that one side of the board can be used to prepare the paper on, the other side to finish it; the board should be so arranged that it can be firmly fastened at the bottom. At the top of the board should be fastened two common spring office clasps, generally about twenty inches apart; these hold the sheet of paper in position; an inch tack at each bottom corner to hold it from curling. To remove the sheet from the board draw the tacks at the bottom, hold them between the thumb and forefinger, catch the paper at the upper corners between the third and fourth fingers, and with the other fingers press the clasps, which frees the paper, remove to rack, and tack it.

Combination "C" should be kept in a tight-corked bottle, in the dark, and shaken well before using. To prepare the paper place it on the board as described. Pour into an earthen bowl the amount of "C" that is required, and with a soft hair brush about three inches wide go over the sheet in a vertical direction, taking great care that one place is not gone over twice, for in this largely lies the secret of success; this operation must be performed very rapidly, so that the part of the sheet where the solution was first applied will not get dry before it is rubbed down; next take a soft linen cloth, wet it in the solution, and rub the chemical evenly over the paper. I mean by this, more evenly distribute the solution that was applied with the brush. I wet the cloth simply to make it as soft as possible, not to apply more solution. Preparing the paper requires a great amount of care and considerable skilled work. Some draftsmen use only a brush to prepare the paper with, but I can make the two give the best results. The paper is exposed in the same manner as a blue print; when cured the lines on the shee will be of a delicate yellow, and the paper white; remove from frame and place it on opposite side of board from which it was prepared on; in a bowl, and on a heaping teaspoonful of gallic acid pour half or two-thirds of a cup of boiling water; now with another hair brush apply this mixture; this will turn the lines black; this should be done rapidly and evenly, after which rinse the drawing in water; we now have a handsome white print—that is, if it has been evenly done, but more likely it will be streaked; however, time and practice will remedy this last evil.

The International Congress on Inland Navigation, recently held at Manchester, England, took strong grounds in favor of the construction and maintenance of waterways, as affording cheap means of transportation. The development of waterways and railways together was also favored, the ground taken being that both would be benefitted thereby, owing to the greater commercial development.

Some years since, the question was raised in the AMERICAN MACHINIST as to whether a locomotive boiler had ever exploded when under motion. was settled that such instances had occurred. In confirmation of the probability of this, a locomotive boiler recently exploded on the Pennsylvania & Ohio road just as it was pulling into Pavonia, a small station near Mansfield, Ohio. The engineer and fireman were instantly killed, and a brakeman on the fourth car from the engine was thrown seventy-five feet, but escaped with slight injuries.

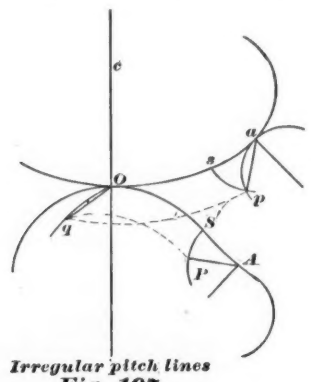
Odontics, or the Theory and Practice of the Teeth of Gears.

BY GEO. B. GRANT.

THIRTEENTH PAPER.

126.—NON-CIRCULAR PITCH LINES.

The consideration of pitch lines that are not circular, and of the teeth that are fitted for them, is an interesting but not particularly important branch of odontics. Such pitch lines are largely used for producing variations



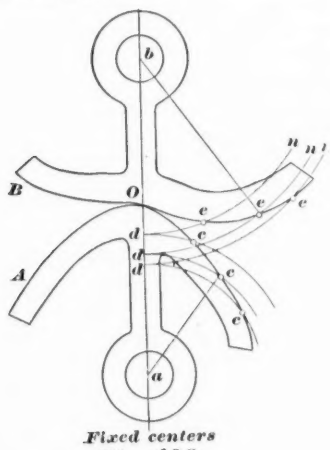
Irregular pitch lines
Fig. 107.

of speed and power, but have no other practical applications.

127.—THE IRREGULAR PITCH LINE.

The most general case is that of two indefinite irregular curves rolling together, Fig. 107, the only condition being that they shall be so shaped that they will roll together continuously.

As the practical importance of the free pitch line is very small, we shall not examine it in detail.

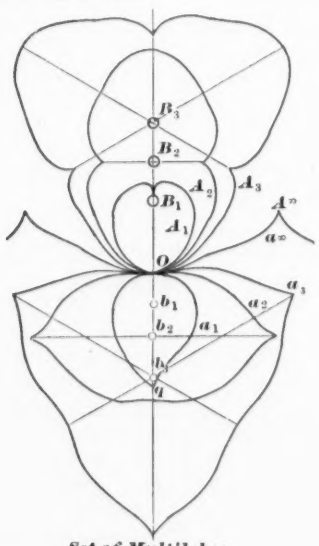


Fixed centers
Fig. 108.

128.—PITCH LINES ON FIXED CENTERS.

When we attach the condition that the two pitch lines shall revolve in rolling contact on fixed centers, we have a definite problem of more interest and importance than that of the free pitch line.

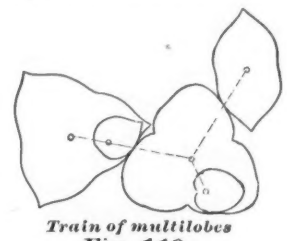
If, as in Fig. 108, we have a pitch line A revolving upon a fixed center a, we can construct a pitch line B that will roll with it, and revolve on the given fixed center b, by the following process.



Set of Multilobes
Fig. 109.

From any pitch point O, step off equal arcs Oe, ee, ee; draw circular arcs cd from the center a; draw circular arcs dn from the center b; step off the same equal arcs Oe, ee, ee, then $Oeee$ will be the required mating pitch line.

These curves will always be in rolling contact at a point on the line of centers ab, the



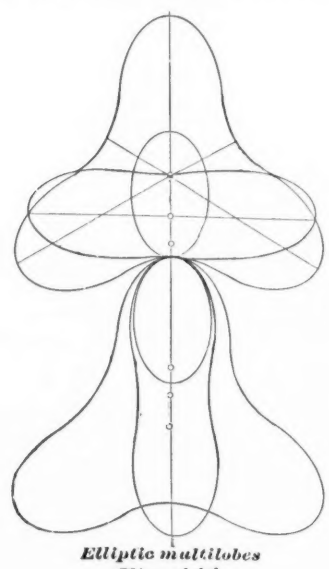
Train of multilobes
Fig. 110.

pitch point and the angle of the curves with the line of centers continually changing.

The velocity ratio of the curves will be variable, and always equal to the inverse proportion of any two mating radiants, ac and be.

129.—CLOSED PITCH LINES.

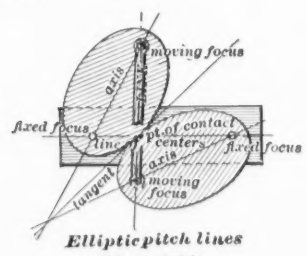
When one of the curves of Fig. 108 is a closed curve, the other will in general not be closed, but by trying different centers, a curve can be found that will be closed.



Elliptic multilobes
Fig. 111.

If the closed curve a_1, Fig. 109, is taken, the mating curve A_1 will be closed when the center is chosen at a certain point B_1, that can be found by repeated trials.

The mating closed curves thus constructed will seldom be alike, but will always have points of similarity. A salient point q on one will be paired with a reversed point or notch on the other, and lobes on one will be represented by depressions on the other. Half a revolution of one of the curves, from any position, will turn the other through half a revolution.



Elliptic pitch lines
Fig. 112.

130.—MULTILOBES.

If, after finding the center B_1, Fig. 109, for the closed mating curve, other centers are tried, second, third, and succeeding centers, B_2, B_3, B_4, will be found, about which the mating curves will also be closed.

These closed curves, called multilobes, will be each divided into like lobes, the second curve, or bilobe, into two lobes; the third, or trilobe, into three lobes, and so on.

If the center is placed at infinity, the rack lobe A_∞ will be formed.

If the center be taken negatively, on the same side as the original center b_1, at b_2, b_3, b_4, etc., negative multilobes a_2, a_3, a_4, etc., will be formed about the original curve a_1.

All these multilobes, positive and negative, will roll together collectively about their fixed centers, in rolling contact at a common and shifting pitch point O.

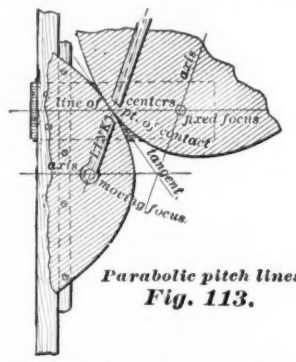
Any two, of the same sign, will roll in internal contact, and any two of opposite signs will roll in external contact, so that they can be formed in train, Fig. 110.

When it so happens, as it does with the ellipse revolving on its focus, or the logarithmic spiral revolving on its pole, is taken, that the first derived pair of curves, or unilobes, are exactly alike, all the multilobes will be alike; the positive trilobe like the negative trilobe, and so on, so that any two curves of such a set will work together in either internal or external contact, Fig. 111.

131.—CONIC SECTION PITCH LINES.

If two like conic sections are mounted upon their foci, they will roll together.

Their free foci will revolve at a fixed distance from each other, and may be connected



Parabolic pitch lines
Fig. 113.

by a link. The line of the free foci will intersect the line of the fixed foci at the point of contact of the pitch lines.

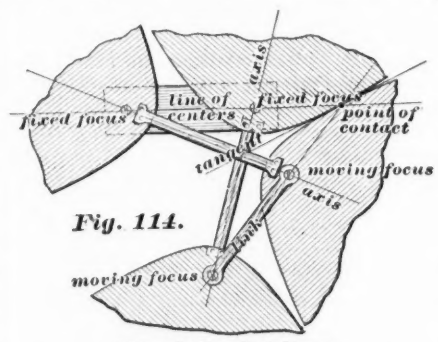
Fig. 112 shows a pair of ellipses, Fig. 113 a pair of parabolas, and Fig. 114 a pair of hyperbolas.

The elliptic pitch line is the only one known that will revolve with its equal, and make a practical and complete revolution.

132.—THE LOGARITHMIC SPIRAL.

If the radiants a, b, c, d, e, Fig. 115, make equal angles with each other, and each one is equal to the adjacent one multiplied by a constant number, their extremities will determine a logarithmic spiral.

If the first radiant a is given, with the constant multiplier n, the second radiant will be



Hyperbolic pitch lines
Fig. 114.

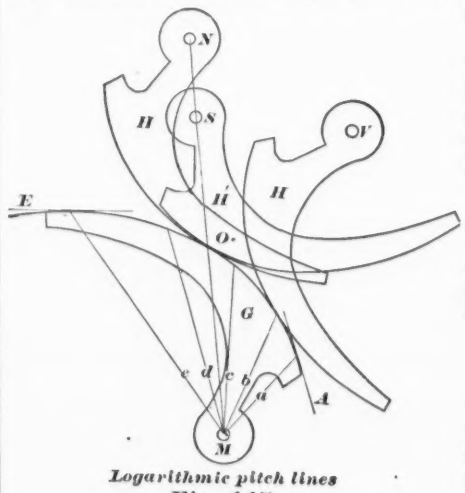
na, the third will be $n^2 a$, the fourth will be $n^3 a$, and so on.

If the first and last radiants, a and e, are given, and there are p equal angles between them, the constant is

$$n = \sqrt[p]{\frac{e}{a}}$$

so that it is a simple matter to construct a logarithmic spiral to connect any two given radiants at any given angle with each other.

The curve possesses the singular property that all tangents, A or E, make the same angle with the radiants at their points of con-

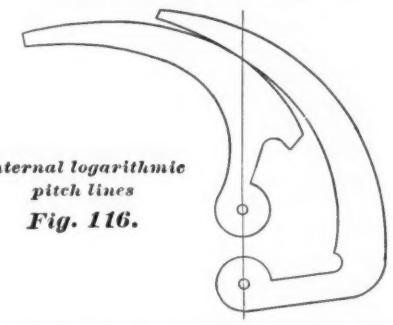


Logarithmic pitch lines
Fig. 115.

tact. The curves are always inclined to the line of centers at the constant angle.

The curve continually approaches the center M, or "pole," making an infinite number of turns about it, but never reaching it.

It also has the entirely useless property that

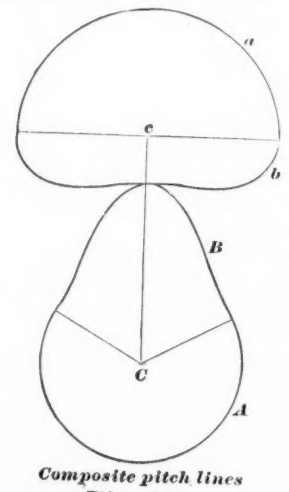


Internal logarithmic pitch lines
Fig. 116.

the pole will trace an involute of the base circle if it is rolled upon the pitch circle (75).

It possesses the property, not possessed by any other curve, that it will roll with an equal mate on fixed centers that can be varied in position. The curve H will roll with the curve C, whether its pole is at N, or at S, or at V.

Fig. 116 shows a pair of logarithmic spirals in internal contact.

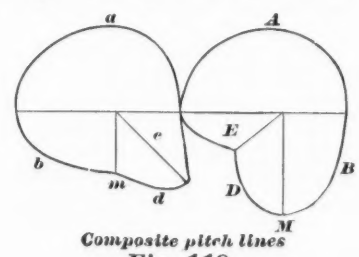


Composite pitch lines
Fig. 117.

133.—COMPOSITE PITCH LINES.

Instead of drawing a curve at random, and finding the mate to run with it, Fig. 108, the complete pitch line may be built up of a number of curves, of which the properties are known.

Thus, Fig. 117 shows composite gears, consisting of circular parts A and a, and an elliptic trilobe B, working with an elliptic bilobe b. Fig. 118 shows a combination of a pair of logarithmic spiral arcs A and a, a pair of elliptic bilobal arcs B and b, a pair of logarithmic spiral arcs D and d, and a



Composite pitch lines
Fig. 118.

pair of elliptic quadrilobal arcs E and e. An endless variety of combinations can be made in this way.

It is not necessary that the component curves be tangent, if they succeed each other continuously. Fig. 119 shows a pair of equal logarithmic spirals with a break at ab, the action at b commencing just as it ends at a.

Care should be taken to avoid salient points, breaks, andi nterruptions of the continuity of the curve, for there must be defective tooth action at such points. The curves should run smoothly into each other with gradual changes of curvature.

134.—TEETH OF NON-CIRCULAR PITCH LINES.

The action of the teeth of non-circular pitch lines does not, at first sight, appear to follow the laws pertaining to circular lines, but there is really very little difference.

If we consider the two pitch lines to be free, and to be so moved while they roll together that the pitch point O, Fig. 107, is fixed, and so that the fixed line c C is always at right angles to both curves at their com-

mon point O, the laws of the tooth action will be almost precisely the same as laid down for the circular pitch line. Fig. 107 may be easily applied to (24) as illustrated by Fig. 15.

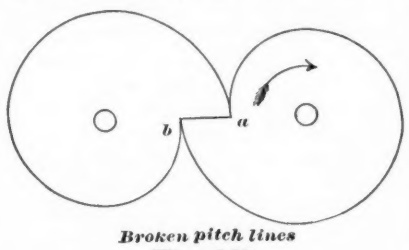
When the centers are fixed, the same tooth action takes place, but the line of action and the pitch point continually change their positions.

The teeth of non-circular pitch lines can therefore be formed either by conjugating a given odontoid, as in (24), or by the rolled curve theory of (32).

By all means the most practicable method, when the circumstances will permit, is to make up the curve by joining approximating circular arcs, and to provide each circular arc with teeth in the ordinary way. See this process as applied to the elliptic pitch line at Figs. 129 and 130. [See later issue for these.]

135.—TEETH AT SALIENT POINTS AND BREAKS.

When there is a salient point, or other interruption of the continuity of the action, as at q, Fig. 109, or at Mm, Fig. 118, there must be



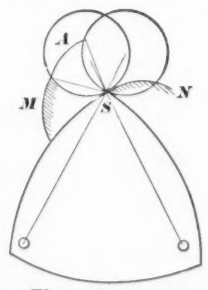
Broken pitch lines
Fig. 119.

an interruption in the arrangement of the normals of any tooth curve, and a consequent failure of the tooth action.

Fig. 120 shows a cycloidal tooth curve M, at a corner or salient point S, between two circular pitch arcs. There is a circular arc A on the odontoid made while the describing circle is turning about the point S, and that arc can have no continuous tooth action. Therefore the tooth action will fail, unless the next tooth curve N springs from the salient point.

If a tooth springs from the salient point, the tooth action will be correct, but mechanically imperfect, as the arc of action of two teeth cannot lap over each other to allow for practical defects. And then, as two tooth curves cannot spring from the same pitch point in opposite directions, such gears can run in but one direction, and are not reversible.

When there is a break, as at ab, Fig. 119, the teeth must be so cut off that they will separate at a just as they engage at b, for there



The salient point
Fig. 120.

is a sudden change in the velocity ratio. Such combinations are practicable, but in every way undesirable.

136.—THE ELLIPTIC GEAR.

The principal, and almost the only use of the irregular gear, is to produce a variation of speed between certain given limits, without conditions as to the variations of speed and details of the motion between the limits. When that is the only object, the elliptic pitch line is the only one that is required, and it is chosen because it is the only known continuous closed curve that will work in rolling contact with an equal mate, and because it is, next to the circle, the simplest known curve. Of the elliptic multilobes, the unilobe, or simple ellipse, revolving on one of its foci as a center, is the only one used to any appreciable extent, and therefore is the only one that requires examination in detail.

The use of the elliptic gear is practically confined to producing a simple variation of speed between known limits, and to producing a "quick return motion" for planers, shapers, slotters, and similar cutting tools, as well as for pumps, shears, punches, shingle machines, and others where the work is done mostly during one-half of the stroke of a reciprocating piece. The work of a planer tool or of the plunger of a single acting pump, is all done during the motion of the tool, or of the plunger in one direction, and the only object on the return is to get the piece ready for the next useful operation in the quickest possible time.

For an example, the bobbin of a spinning machine is to be wound in a conical form, the thread being fed to it through a moving guide, and the necessary variable motion of the guide, fast at the point of the cone, and slow at its base, is best given to it by a pair of elliptic gears. For another example, the motion of the platen of a printing press should be rapid when the press is open, and slow and powerful when the impression is being taken, and the object can be reached best by a pair of elliptic gears operating the platen.

The practical uses of the elliptic gear are endless, and it would be in greater use and favor, if it were not for the fact that its production, by the means ordinarily in use for that purpose, is as difficult and costly as the resulting gear is unsatisfactory.

137.—THE ELLIPSE.

To thoroughly understand the construction and operation of the ellipse, it is necessary to learn but a few of its many properties.

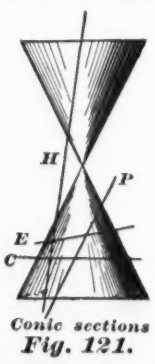
The mechanical definition of the ellipse is that it is one of the "conic sections." If the cone, Fig. 121, is cut by a plane C at right angles with its axis, the outline of the section will be a circle; if the plane E cuts the cone at an angle, the section will be an ellipse; if the plane P is parallel with the side of the cone, the section is a parabola, and if the plane H is at such an angle that it cuts both nappes of the cone, the section is a hyperbola. All these curves will roll together when fixed on centers at certain points called foci, but the ellipse, and its special case, the circle, are the only ones that are capable of continuous motion.

In the ellipse, Fig. 122, the point C is the center, the longest diameter, AA', is the major axis, the shortest diameter, BB', is the minor axis; A and A' are the major apices, and B and B' are the minor apices.

If an arc be drawn from the minor apex, with a radius equal to the major semi-axis, it will cut the major axis at points F and F', called the foci, and one focus must be chosen as the center, about which the curve is to revolve if used as the pitch line of a gear.

It is a property of the curve that the sum of the distances, PF and PF', from any point to the foci is equal to the major axis, AA', and this feature is used as a means of constructing the curve by points. Draw any arc at random from one focus with radius FP. Draw an arc from the other focus with a radius equal to $AA'—FP$, and it will cut the first arc at a point of the ellipse. When the point P is near either major apex, the arcs intersect at such a sharp angle that the method is nearly useless.

Another, and much the best known method for constructing the ellipse by points, is to draw

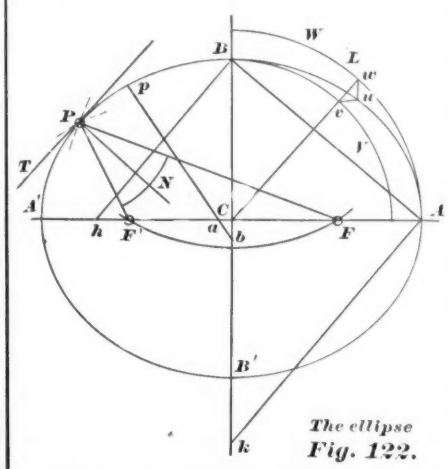


Conic sections
Fig. 121.

any radial line L, and also circular arcs W and V, from the center through the apices. From the intersections, w and v, of the radial line and the circles, draw lines parallel to the axes, and they will intersect, always at right angles, at a point u on the curve. This method is very accurate, and has no failing position.

Another valuable property of the ellipse is that if the line pab be so drawn that the distance pa is equal to BC, and pb to AC, the point p will be upon the curve if the points a and b are upon the axes.

The curvature of the ellipse is an important feature in connection with its use as a gear pitch line. It is sharpest at the major axis



The ellipse
Fig. 122.

A, and flattest at the minor apex B, elsewhere varying between the two limits.

The radius of curvature at either apex, that is, the radius of the circle that most nearly coincides with the curve, is found by drawing the lines Bh and Ak at right angles with the chord AB. The distance Ch is the radius of curvature at the major apex A, and the distance Ck is the radius at the minor apex B.

The normal PN to the curve at any point P bisects the angle FPF' between the focal lines, and the tangent PT is at right angles to the normal.

LETTERS FROM PRACTICAL MEN.

Notes on Machine Design.

Editor American Machinist:

As Mr. Woodward, in his Notes on Machine Design, takes occasion to emphatically condemn the swinging lathe head for boring tapers, it may not be out of place to consider the consistency of his own suggestions. Perhaps I do not fully comprehend the advantages of having a lathe head-stock cast rather than bolted on, but as about the only lathes I ever built were made that way, naturally I have some notions favorable to it.

From the gist of Mr. Woodward's article, one cannot fail to infer that why he advocates the casting-on plan is for strength, and as all the strain on a head-stock must come on it through the spindle, and as the greatest strain is up, then the cast-on is better than the bolted-on one, because it cannot lift. The strain comes on the spindle first, and how the two bolts that hold the cap on Mr. Woodward's lathe are going to stand the strain any better than the two bolts that hold the head-stock on mine is something that I do not understand.

While he condemns the bolting-on in general, he condemns the swinging head in particular, although he fails to explain why, if four bolts will hold it as a fixture, they will not hold it equally well after it has been moved, if they are tightened to the same degree. If he calculates there is danger of its slipping, should he try it he would find that he slipped up on his calculations. Swinging lathe heads could be made, likely have been made, like some men's heads, more of a nuisance than anything else; mine may be so, but judging from the action of the men, I am persuaded that it is a good thing to have one lathe in a shop with a swinging head.

We have a Pratt & Whitney machine with a Slate taper attachment, kept in as good condition, probably, as the average, but for boring taper holes it is not, and from the nature of its construction cannot be as good as the swinging head. One wants to bore taper holes with the large end out, and to commence at the outer end and bore in, and that is where, in the taper attachment, the man is at the mercy of lost motion.

I do not wish to be understood as objecting to casting the head-stock on the bed; in fact, I should in general cast the whole thing on, and have no half-way business about it. But if I wanted a lathe with a swinging head to bore tapers, I would make it to swing, and so when it was fastened it would be as near a solid casting as possible.

Mr. Woodward, in condemning the swinging head, has the best endorsement in the world—"Chordal," but perhaps neither Chordal nor he have ever seen a good one. Another objection, aside from the strength, is the difficulty in returning it to zero—and yet astronomers do exactly the same thing to determine the parallax of a star ten thousand million miles away. Well, after all, that is not boring a parallel hole.

Thinking this matter over, more especially since reading Mr. Woodward's criticism, I am disposed to take this ground, that if it is to be bolted on at all, the swivel plan is the better way of the two. Wm. Sellers & Co., Incorporated, build lathes arranged so the foot-stocks can be set over slighuly, not for turning tapers, but to adjust them for turning straight.

And so with boring, many lathes do not bore straight, and all may sooner or later wear so they will not. When one does not, is there a more simple or better way to make it than to swing the head on the bed, and if you want it to stay there, bolt it down and let it alone? With a 2-inch hardened and ground steel king-bolt to keep it central, it is absurd to say that three or four good bolts will not hold it. Of all the bad things in the 16-inch lathe referred to, the swinging head-stock is not the most objectionable.

JOHN E. SWEET.

Crane Chains.

Editor American Machinist:

Referring to Mr. Dutton's paper on crane chains, it should be remembered that the chain link is exposed to bending strains as it passes around the curved face of the sheave. The smaller the sheave, the greater the bending stress, and in extreme cases this bending stress exceeds the elastic limit before the straight portion of the chain is unduly loaded. In this event the links are undergoing a constant bending and straightening operation, which must result in destruction more or less rapid, according to the quality of the material.

I make it a rule, as far as possible, to make sheaves twenty diameters of the size of chain used. Thus a 1¼″ chain would have 22″ sheaves.

It would be instructive for your interested readers to analyze the bending strains that occur in a 1⅛″ chain, transmitting 25,000 pounds around a 16″ sheave. Assuming the curved face of the sheave to be incompressible, they will find certain fibers strained over 80,000 pounds per square inch. Evidently all that saves the chain from instant rupture is that the face of the sheave flattens to some extent and relieves the bending strain on the link.

The angular movement of the links on each other is greater on small than on large sheaves, and the bearing surfaces of chain links are so small and imperfect that the life of a chain passing over small sheaves will necessarily be shorter than if the sheaves are large.

J. CHRISTIE.

Making Corrections on Tracing Cloth.

Editor American Machinist:

I would like, through your columns, to offer to the correspondent signing himself J. L. B., Jr., to article "Preparing and Making Corrections on Tracing Cloth," the suggestion that he use the glazed side of the cloth, first rubbing well with blotting board, which imparts a microscopical roughness, thereby increasing friction, and causing the ink to very readily adhere to the surface of the cloth. I have been following this course for some years to my entire satisfaction, using Faber's artists' rubber to erase from the glazed side of the cloth very successfully, leaving the cloth without blemish other than a slight dullness, not to be for once compared to the unsightly scar of a steel eraser, besides facilitating the re-use of the space for drawing upon, unaccompanied by either blur or blot. The glazing on the cloth tends to throw the drawing

out in bold relief, which is very pleasing to the eye. Following this method, to me a correction never means a blot. I think this method is far superior to the "dull side" and "steel eraser" process.

W. H. BALTZELL.

That Cupola Explosion.

Editor American Machinist:

The cupola explosion of Cassidy & Adler, of New York City, seems to be very much of a mystery, and the theory of Mr Fennell, of Racine, Wis., seems to me to be the most correct yet advanced. Messrs. Rogers & Collins' ideas are feasible, perhaps, though it hardly seems sufficient force could be generated to produce such results. But I cannot imagine what kind of a cupola Mr. Collins could have had that would run an hour and a half after the blast was put on without tapping out.

I remember reading an account of a cupola explosion a number of years ago, that was caused by taking off a large heat, in a comparatively small cupola, immediately after re-lining clear to the charging doors, and without thoroughly drying the lining, which in this case had been put in with an unusual amount of grouting behind the brick, which was wet up thin and poured in so as to leave no cavities. The shell being tight, and the brick laid close, the heat generated sufficient steam from the moisture in the grouting to tear away the side of the shell, it being the weaker point. Several of the workmen were slightly scalded and burned, but none seriously injured. It served, however, to teach the writer the importance of pretty thoroughly drying out a cupola before taking off a heat.

On another occasion, several years ago, a foundry in which the writer was employed was using large quantities of scrap, that was shipped in car lots, when among the rest was discovered what had every appearance of being a loaded shell, and this, too, just as it was about to be placed in the cupola. It is needless to say that it was put where it would never do any harm, and there were no chances taken as to whether it was loaded or not. Instances of this kind are not improbable, and is it not possible that the explosion referred to came about in this way?

W. A. JONES.

Water Necromancy.

Editor American Machinist:

All who have read Scott's Antiquary will remember something of one "Dousterswivel," and his supposed magic in discovering hidden treasure. There has always been in rural districts, a belief in the efficacy of the divining rod for the discovery of water. Well, I have seen an actual divining rod—held it in my hands—though I stopped short of the sacrilege of attempting to use it. I will describe it. It consists of a forked twig, preferably of the hazel tree, because each small branch of this tree ends in a forked twig, and generally the hazel gives best results. This twig, as per sketch, like a letter Y, is held by its thin ends in both hands, the twig ends being held under the thumb and over the middle bit of the first finger, the hands being nearly clenched, with thumb nails uppermost. The thick end or base of the Y then points downwards. Thus equipped, the water wizard walks over the ground, and when he comes over hidden water, the twig twitches upward, in spite of the thin ends being firmly held.

Now, in common with most others in this scriptural age, I have always held that all such carryings on were mere witchcraft. A week ago business took me into a western county, not many miles from a place called Broadway, and I was told of this twig business. It seems a man, formerly a mason, found he had the property in question, and so has since devoted himself to twiggery as a profession, and an easy mode of livelihood, so I began to make inquiries. One man, a well informed, educated man, told me that not merely did the twig indicate water, as the wizard passed over a stream, but that, a little sleight-of-hand being alone sufficient to account for this, he himself led the man across a field, wherein he alone knew of the position of the field drains. In every single instance the twig indicated, as the man crossed the line of drain, and further it discovered for my friend a drain, which he himself wished to locate, as he wished to have it up for repairs, and had not its place marked on his farm plan.

One day the man was taken out by skeptical men, amongst whom was a Royal Navy engineer, determined to have some fun. This man, who had, so to speak, "come to curse," "remained to pray," and was converted to the idea that there was something in it. He himself held the twig without result, but when the wizard grasped him by the two wrists the twig indicated when they stood over water—a small stream—just as it did when held by the wizard himself.

A lady held the twig, and despite her efforts to the contrary, it indicated water when her wrists were held by the man. He did not profess ability to determine the quantity, or its depth from surface, but my friend tells me that a large firm of engineers, who employed this man, were told by him there was *no* water under their ground, and have since thrown away much money in seeking water by boring, with no success. It is also said the man is powerless, if he were to stand upon glass.

Now, I want to know in the face of this, which I am less inclined to doubt, seeing that it was vouched for by a clear-headed man who was wholly disposed to doubt the possibility, and gave the subject a thorough test, whether such a thing has any existence in America. It is said there are about 6 persons in England who are known to have this power of influencing the twig. If there is anything in it, what is the cause or mode of action? Those whose wrists he grasped, stated they experienced a slight tingling sensation in the fingers. Naturally, my friend, whose drains were spotted out when he alone knew their lay, was very positive as to there being something in it, as also was the engineer, a man of high attainments, and well known.

We ourselves are carrying on a deep earth boring, at a spot where the twig indicated water, and water stands in our boring within 100 feet of the surface.

The whole subject is so connected in one's mind with the science of humbug that it is very hard to give credence, even to the positive evidence of careful investigating men. The country round is so primitive, and so removed from beaten track, that one is disposed to believe that such a practice might well be a survival there of the middle ages. In the next town, which was a thriving place in 1600 to 1700 A. D., but is now the sleepiest old-world place I ever entered, almost every house has a sun-dial upon its front wall, and many are dated fully 200 years back, and of very substantial and good architecture. I did not known there was such a place in all England, and how people live is a marvel, and yet they do live, and are most comfortable, rents of houses varying from 24 cents a week for small cottages to nearly 4 dollars, which is the rent of an Elizabethan mansion of many gables, as large as a 5th avenue Vanderbilt domicile.

Now, tell me is this twig business genuine? Has it a basis of scientific fact? Is there a peculiar electric state of some bodies, which will account rationally for the phenomenon?

Though I had the support of Mr. Coleman Sellers in respect to the 40-foot pumping of water, it is evident by the numerous adverse criticisms on that subject, that I must not with too much levity commit myself to anything positive on this water witchery, or no reader of the AMERICAN MACHINIST will ever read anything I may ever pen. Herein, then, let me pose as a mere doubter, anxious to learn, if this be one of those things not dreamt of in our philosophy.

It is with positive diffidence that I venture even to sign my name to this. Should it bring me to the stake, as one in league with the evil one, will it find water to quench me?

W. H. BOOTH.

Graduated Dials.

Editor American Machinist:

Apropos of the remarks of "Mechanic" in your issue of Aug. 21, 1890, I would say that there are some graduated dials in existence that might be vastly improved by the expenditure of a little thought on the part of the makers. Many of us are more or less familiar with the form shown in Fig. 1, whose chief charm lies in the fact that the pointer generally covers up just the particular part of the dial that the operator wants to see. The 5 and 10 lines in any dial are

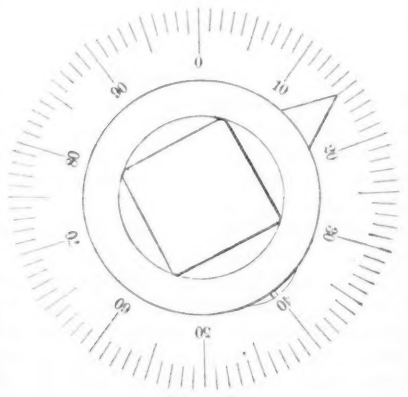


Fig. 1.

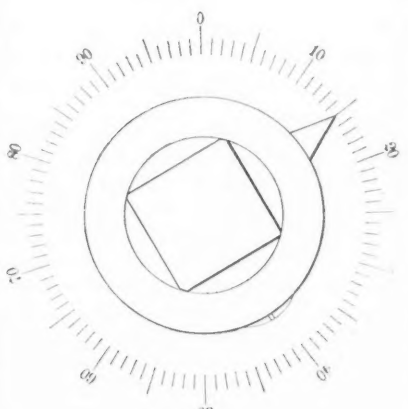
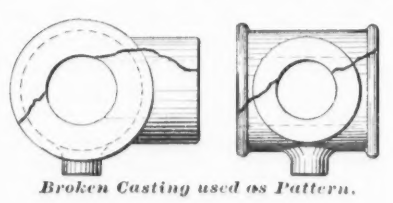


Fig. 2.

usually made longer than the others to catch the eye quickly, but if this extra length is covered up by the pointer it isn't of very much use. When the pointer happens to be near one of the 10 lines it covers, either wholly or in part, the number belonging to that particular line. Fig. 2 can be read or set quicker and with more certainty than Fig. 1, and yet the point at which the reading takes place is on a radius only about 5 per cent. less than in Fig. 1. Any one who has used both cannot fail to perceive the superiority of the arrangement that leaves the entire dial exposed at all times.

WALTER GRIBBEN.



Broken Casting used as Pattern.

Using Castings for Patterns.

Editor American Machinist:

Experience has shown me that it is not known to every one that sometimes castings, broken or otherwise, may be fitted up and used for patterns, so I thought I might do worse than give some examples for publication, if you will kindly give it space in your valuable paper.

I have chosen a small casting belonging to a hand boring machine, which, being broken, somewhat as shown in the annexed drawing, the owner wished renewed. Not caring to pay for a new pattern, he was advised to try if the molder would not help him out. The result was, a casting obtained without any fixing, except the following: After the "drag" was rammed up, the pattern (we will call it) was held together by the finger and thumb, and the holes filled with molding sand, ends smoothed off, and bedded to one-half of its circumference in the drag. Then it was an easy matter to mold the other half in the cope, after which it was drawn from the mold with the finger and thumb. Of course the holes in the new casting had to be drilled before boring and reaming. If a proper pattern had been made we should have cored the holes.

WM. NEWTON.

[We had supposed that it was generally known that broken castings could very frequently be used as patterns, but as our correspondent finds those who do not know it, we give such the benefit of his communication.]

About Measurements.

Editor American Machinist:

Your issue of August 21, 1890, page 11, "About Measurements," carries my mind back to the year 1863, when I applied indexed disks and pointers to the vertical and cross-feed screws of planers, and soon after to the slide rests used in the machine shop of the American Watch Co. About eight years ago the device was patented, so I am now told by the workman who was running the planer at the time I applied the idea.

Many of the finer systems of measurement were developed in the watch factories, and these establishments not being open to the general public, the ideas have not spread as rapidly as they might have done. I believe the history of mechanics will show that the watch industry has developed more accurate workmanship and finer mechanical devices than any other industry in existence, and it is a great pity that those establishments are not more generally open to the inspection of mechanics. If they had been so, ideas which are now brought out as new would have been in general use many years ago.

A. WEBSTER.

Give the Throttle Valve Freedom.

Editor American Machinist:

I know of a road that put safety valves on all their locomotive chests, to prevent their breaking. I also remember at one time working on a road where some new engines were received. The chests were heavily ribbed, but they broke when reversing at high speed. This was, at the time, something new for us, so we went looking for the trouble. We found when the throttle lever was shut hard, and the latch in firm, that the yoke in the dome was hard down on the valve, so it could not lift to give relief. The chest, being the weakest thing in the way of the pressure, had to give way.

The old slide throttle, having no latch to hold it, would, if you reversed it at high speed, fly open or lift from its seat, relieving into the boiler and out of the safety valve. But what a pull it took to handle one of these throttles. Not uncommonly you had to oil the cylinders and reverse to oil the throttle before you could get any comfort from them. But with the old slide throttle we never heard of steam chests or steam pipes broken by reversing.

I think if the throttle is looked after a little, and left so it has freedom to lift, say $\frac{1}{16}$", chests will not be broken.

ENGINEER.

The Hindley Worm and Gear.

Editor American Machinist:

In your issue of August 21st, 1890, Geo. B. Grant, on the subject of worm gears, says respecting the working contact surfaces of the Hindley worm and gear teeth, that "the real contact is not yet certain. The contact may be linear, along some line of no great length, but it is probably a point contact on the normal section."

About two months ago I had occasion to make a careful analysis of the Hindley worm and gear, as respects their driving contact surfaces. This I did to satisfy myself respecting the claims for superiority of this class of gearing; and the result of my investigations have thoroughly proven to me that the working contacts are *lines* in a plane through the axis of worm, perpendicular to axis of gear, it being assumed that these gear are produced in accordance with method shown in Mr. Grant's article. This line contact is simultaneous with all teeth encompassed by the worm's length.

If the first, or end tooth surface of worm, which is perpendicular to the worm's axis, and provided the spiral course of tooth was

infinitesimal, this tooth surface would then exist as a dead plane. Furthermore, this part of the worm's length being of largest radius, a hob made in accordance would do the final forming of the teeth in the gear, which would result also in dead planes, giving surface contact at this point of the worm's length. Of course this infinitesimal condition of helical gear does never occur, but its assumption points to where the line contact of teeth surfaces would merge into plane or surface contact. This foregoing assumption is a fair one, as all helical gears obey their respective principles respecting working contact of their teeth surfaces independently of the angle of the tooth's spiral.

Some time ago I had occasion to visit an establishment where the Hindley gear is being produced, and learned the fact that the final fitting of the worm and gear to each other is done by grinding them together. This process entirely eliminates the character of contact of the surfaces of the teeth, and they no longer obey the principles inherent in their first or previous stage of production, but are more perfect in contacts. This satisfies me that the results, following for a time, of continued wear, are beneficial instead of hurtful to the performance of this gear.

H. C. HECKENDORN.

Boring Taper Holes.

Editor American Machinist:

I noticed in a late number of the AMERICAN MACHINIST an article on boring taper holes, and send a sketch of a bar I made many years ago for boring taper holes in cranks for wrist-pins. The mounting is not shown, but consists of the ordinary boring-bar clamps, with sleeves adjustable by set-screws. The arrangement is, perhaps, not very clearly shown, and a short description may not be out of place. It consists of a (steel) bar, with an enlargement near the middle of its length. This enlargement is set at an angle with the axis of the bar. On this is fitted a sleeve (or several sleeves of different diameters), feathered to slide easily. The cutter is held in a suitable slot by a set-screw, as shown. This sleeve is drawn along the bar by a cross-key, sliding in a slot cut through the enlarged part of bar, the seat in sleeve being slotted, as shown, to allow for side movement of key in sleeve. This key is drawn by a right-hand threaded rod, through which it passes, the rod being moved by the gears shown at the end of bar. The gears *C* and *E* have (in this case) each 31 teeth, and *D* and *F* each 36 teeth, and the lead of screw is 12″ to 1″; this gives a feed of about 48 cuts to the inch. If the nut (or gear *F*) was prevented from revolving, of course the feed would be 12 to the inch; but as the train gives about three-quarters of a revolution to gear *F* to one revolution of bar, the resultant is a forward movement of one quarter of $\frac{1}{12}$″, or 48 to the inch.

The bush, or sleeve, in clamp used in front, was made larger than any wrist we expected to have, and when the hole was brought nearly to size wanted the bar was slipped out and pin tried in; then if, for instance, the pin went to its place within $\frac{3}{16}$″, the bar was put in again, but moved endwise just the $\frac{3}{16}$″, and another cut taken *without moving the tool;* and it was an absolute certainty then that the hole was the right size.

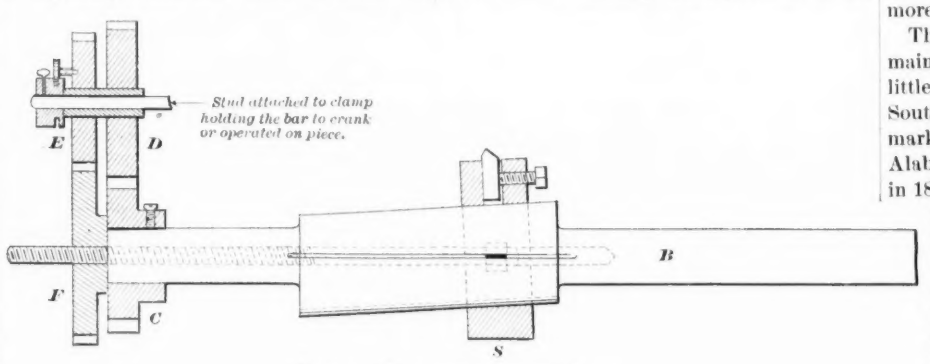
The pins were previously fitted to holes bored with the same bar in templates convenient for handling in the lathe. In this way they could be finished beforehand, with no danger of having a misfit. The bar bored so perfect a hole that if the pin was properly fitted to template, no grinding whatever was necessary. Of course, the boring was done after the crank was on the shaft, and the bar could easily be put in perfect line with shaft.

This tool may not be a new thing to many, but I never saw anything like it on the market or in the shops. E. S. NEWTON.

Notwithstanding the press outside of Chicago makes merry over the lack of preparation for the World's Fair, we have faith that Chicago will be along in time for the jubilee. Chicago is a rustling city, and although there will be the usual skirmishing by those who think they have got the inside track on land tenure, the citizens will furnish a site in time. But it must be admitted that there is not much time to spare, and the sooner the matter of a site is settled, the better for the fair. It is a job of no small magnitude to prepare the plans for the necessary buildings, and this cannot be done until it is known where they are to stand. While we have abundant faith in Chicago, it would be reassuring to see her moving a little more speedily in the matter.

Some Things Done Elsewhere.

A gentleman connected with a prominent engineering establishment in this country, who has recently returned from Europe, brought up in a conversation the other day some facts connected with the manner of doing business on the other side of the water which he thought might have as much to do with giving our transatlantic cousins the advantage over us in the building of certain classes of machinery as any of the causes more frequently alluded to. The concern with which he is connected has large shops both here and in England, the latter to build such machinery as is too heavy to be advantageously built here and shipped over. In various parts of Europe they have thirteen branch houses, and it is their practice to carry stocks of machinery at the principal ports of Europe, which are stored in warehouses ready for shipment upon telegraphic or other orders to their destination in any part of the world. These warehouses are not such as are usually found here, but are excellently located, and equipped with every convenience for the rapid and safe handling of anything which may come to them, and



BORING BAR FOR TAPER HOLES.

are so situated that the largest vessels may be brought alongside to discharge or take on freight from or to any part of the world. Then there are tracks connecting with the various systems of railways, and complete plants of steam or hydraulic hoisting and traversing apparatus by which the heaviest machines may be taken from cars or steamers and placed anywhere in the building, or similarly loaded for transportation by rail or water with the greatest ease and freedom from liability to accident. The buildings are usually thoroughly protected from fire, and are first-class in every particular. Such warehouses are found to go a great ways in reducing that usually large proportion of the total expense involved in putting machinery down in place ready for operation after it has been constructed.

This gentleman's experience on both sides of the water also inclines him to the belief that there is less inclination to buy an inferior thing simply because it is made at home in England than is the case here. An Englishman when he sets out to purchase a plant of machinery does not, as a rule, care where it comes from, but wants the best, or, at least, what he considers the best, and is willing to pay a fair price for it.

While as good an American as before he ever saw the other side of the great water, this man, an experienced manufacturer with large interests on both sides, is ready to admit that there are some things to be found on the other side in connection with manufacturing which it would be well to imitate here, and especially in connection with that department of manufacturing enterprise known as the business side of it. Thorough self-examination is as good for communities as for individuals, we presume, and the best American is neither the Anglo-maniac who sees nothing good unless it comes from the other side, nor the Anglo-phobist, who hates everything English, good, bad and indifferent.

Of course, the matters spoken of are the outgrowth of a long development of trade carried on with all parts of the world, and it is probable that as we go on we shall develop similar features here, as the need for them becomes more and more apparent, but during our own development there is nothing which can be more profitable than to examine and fairly consider the good and other features found in foreign countries, and adopt such of them as seem suited to the conditions here.

Institute of Mining Engineers.

According to circular from the secretary, the fifty-seventh meeting of the mining engineers will begin in New York Monday afternoon, September 29, at 2 o'clock. All sessions will be at Chickering Hall, 130 Fifth avenue; hotel headquarters will be at the Park Avenue Hotel. The sessions of the Institute for the reading and discussion of papers will be Monday afternoon and evening, and on Thursday morning, afternoon and evening.

On Wednesday, Thursday and Friday mornings the sessions of the British Iron and Steel Institute will take place.

On Wednesday afternoon there will be an excursion of the two societies, and invited guests, up the Hudson River.

On Thursday afternoon, the Holley Memorial will be unveiled in Washington Square. The commemorative address will be delivered in Chickering Hall, previous to the open-air ceremony, by Mr. James Dredge, editor of London *Engineering*.

Some account of the proposed trip of the members and guests will be found elsewhere in this issue.

Others than members, at the discretion of the general committee, may accompany the excursionists and partake of the entertainments *en route*, at the following rates, which cover railway fares and Pullman berths only:

New York to Pittsburgh and return, $20.

New York to Pittsburgh and Chicago and return, $30.

New York to Pittsburgh, Chicago, and over the Northern or the Southern excursion route and return to New York, $60.

Philadelphia or Pittsburgh over either route and return to starting point, $60.

Applications for joining the excursionists, accompanied with check for the amount of fare, should be made to Charles Kirchoff, 66 Duane street, New York City.

The Iron Trades in England.

The English Iron Trade Employers Association does not take an entirely rosy view of iron and steel industries. According to the report:

In the matter of trade the past few months had seen the commencement of a reaction in the iron and engineering industries, the end of which did not seem to have been reached. The fall in the value of material had gone side by side with a limitation of orders for work in the steamship yards and engine shops of the country, and the increased activity which was hoped for on all hands had not been reached by employers, who were looking for such an improvement as would have satisfied them in declaring trade good and fairly profitable. Taking a general survey of the trade of the official year, it must be reluctantly declared that it had not been a profitable one to engineers, as the sudden increase in the volume of work produced by no means ministered to their profits. The rising prices of material, and the immediate and often extravagant demands made by workmen for increased wages, rates and diminished hours of labor, had told greatly against the enterprise of the country by the disheartening effect they had had upon those whose capital was necessary for maintaining their national prosperity with special reference to the industries in which their members were engaged. Taking the leading districts where the association had members, the upward tendency of wages might be generally taken at from 10 to 15, or even 20 per cent. There was, however, every prospect that rates had reached their highest point, as trade was on all hands admitted to be falling off; and in the shipbuilding industry its relaxing activity was so distinctly marked as to have a very direct effect upon nearly every other branch of the iron and engineering trades of this country.

Pig-iron Production in the United States.

We have received from William M. Sweet, of Philadelphia, special agent Eleventh Census, Bulletin No. 9, relating to the production of pig-iron in this country. From this it appears that the production for the year ending June 30, 1890, was 9,579,779 net tons. This is the greatest production in any single year. In 1880 the production was 3,781,021 tons; this shows an increase of more than 150 per cent.

The production in New England has remained nearly constant since 1870, being a little more than 30,000 tons per year. The South has, as was to be expected, shown remarkable growth in the pig-iron industry. Alabama, for example, produced 60,336 tons in 1880, and 890,432 tons in 1890; Tennessee produced 47,873 tons in 1880, and 290,747 tons in 1890, and Virginia 17,906 tons against 302,477 tons. Taken together, the States of Alabama, Georgia, Kentucky, Maryland, North Carolina, Tennessee, Texas, Virginia and West Virginia produced 350,436 tons in 1880, and 1,780,909 tons in 1890—a gain of more than 400 per cent. Kentucky produced less in 1890 than in 1880, and Georgia a little more, the gain being in the seven other States.

Pennsylvania is still the great iron-producing State of the country, being credited with more than 49 per cent. of the entire production in 1890. Her production in 1880 was 1,930,311 tons, and in 1890, 4,712,511 tons.

Although there has been such remarkable increase in the production of pig-iron, as between 1880 and 1890, and notwithstanding the large number of new furnaces built at the South, the number of completed furnaces has decreased from 681 to 562. This is owing to the abandonment of small furnaces and the construction of larger ones.

Engineers and mechanics who contemplate going to Mexico for work should be prepared to submit to some privations. It does not take much in that country to insure a foreigner lodging in a beastly jail. He may eventually be declared innocent, but the authorities are in no hurry to bring about a trial, and there is nothing known of *habeas corpus* there. Unless he can interest friends in his own government circles, the prisoner in a Mexican jail has a reasonable probability of waiting two or three years before having his innocence declared.

The "City of New York" beat the "Teutonic" on the outward trip by about two hours. This isn't much in a trip of three thousand miles, but is enough to make honors easy, so to speak, and to give opportunity for another trial of speed. The steamship companies, notwithstanding what they say to the contrary, are probably more interested than the public in these races.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
96 FULTON ST., NEW YORK.

PUBLISHED WEEKLY AT
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

Subscription.

$3.00 a year in advance, postage prepaid in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
BREAM'S BLDG'S, Chancery Lane, LONDON, E. C., ENG., will receive subscriptions for the AMERICAN MACHINIST, at 16/6 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Buffalo News Co., Buffalo, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

NEW YORK, SEPTEMBER 4, 1890.

CONTENTS.

PAGE.
A New Grinding Lathe..... 1
The British Board of Trade..... 1, 2
The New Works of the Straight Line Engine Company..... 2, 3
White Prints. By J. L. Bixby, Jr..... 3
Odontics, or the Theory and Practice of the Teeth of Gears. By Geo. B. Grant..... 4, 5
Letters from Practical Men: Notes on Machine Designs. By John E. Sweet Crane Chains. By J. Christie—Making Corrections on Tracing Cloth. By W. H. Baltzell—That Cupola Explosion. By W. A. Jones—Water Necromancy. By W. H. Booth—Graduated Dials. By Walter Gribben—Using Castings for Patterns. By William Newton—About Measurements. By A. Webster—Give the Throttle Valve Freedom. By An Engineer—The Hindley Worm and Gears. By H. C. Heckendorn—Boring Taper Holes. By E. S. Newton..... 5, 6, 7
Some Things Done Elsewhere..... 7
Institute of Mining Engineers..... 7
The Iron Trades in England..... 7
Pig-iron Production in the United States..... 7
Farewell to Ericsson..... 8
A Notable Meeting..... 8
A New Method of Encouraging Manufactures.. 8
Literary Notes..... 8
Questions and Answers..... 8, 9
Manufactures..... 9, 10
Tools for Brass Work. By Fred H. Colvin..... 10, 11
Sketches of an Apprenticeship. By W. S. Rogers..... 11
Machinists' Supplies and Iron..... 12

Farewell to Ericsson.

The most ardent friend and admirer of John Ericsson who was privileged to witness the ceremonies attending the removal of his body from the marble cemetery in this city to the cruiser Baltimore, could hardly fail to be more than pleased with the manner in which the ceremonies were carried out. We need not repeat the details, as they are probably familiar to most, if not all of our readers through the medium of the daily press and illustrated weeklies, and it is only appropriate to add to the general verdict our opinion that nothing which could add to the solemnity and impressiveness of the occasion seemed to have been omitted.

Ericsson was honored as few men are honored, especially when we consider that twenty-five years have elapsed since his most notable achievements, and a new generation has come up which can only know of his triumphs by the records of history.

Ericsson's success was due primarily to his own natural ability, of course, but much of it is also due to the fact that his parents had discernment enough to perceive his natural talents and sufficient devotion to their duty to make sacrifices to advance him. And finally it was due to Ericsson's habit of hard work. He had opportunities, and when they came to him he was prepared, and grasped them with a hand trained by previous steady and conscientious application. In many respects he did not receive, while living, his just dues, but it is certain that his name will occupy a high place in American history, and that he will be venerated by future generations of his countrymen here and in Sweden. And that is much.

A Notable Meeting.

It is made evident by the comments of the English technical press, that much is expected over there from the visit to this country of the British Iron and Steel Institute, which will take place in October. The Verein Deutsche Eisenhutteleute is also invited, and when these two societies meet the members of similar societies in this country, it will be seen that a most notable gathering will be the result—more notable, probably, in many respects than any which ever has taken place heretofore. It is to be hoped that none of our foreign friends who visit this country at that time will go away disappointed, and a glance at the program laid down for them indicates that at least an effort is to be made to make the occasion a pleasant and profitable one.

The first convention will be in New York City during the first three days of the month, during which a number of professional papers will be read by Americans, these papers being chiefly in the nature of treatises upon processes of manufacture to be seen here, and intended, doubtless, as a sort of introduction, in a measure, to the sight-seeing to come afterwards. During their stay in this city, the bust of Alexander Holley will be unveiled. On the 4th, the start to the West and South will be made, stopping at Philadelphia, Lebanon, Steelton, and Altoona, on the way to Pittsburgh, where four days will be spent inspecting the objects of special interest

An international meeting of the various societies will be held while here, at which papers will be read by some of the visitors. The party will then proceed to Chicago, where it will divide, some going north to the iron and copper mines of Lake Superior and vicinity, the Sault Ste. Marie Canal and Locks and Niagara Falls. The party going South will go all through the newly developed manufacturing regions there, and both will reach New York again about the 26th, from whence they will shortly afterwards set sail for home.

It is expected that manufacturing plants will be quite generally thrown open for the inspection of the visitors, and they will be given unusual opportunities for seeing how things pertaining to their business are done here.

The engineering societies that visited Europe last summer were royally entertained and made to feel that nothing was too good for them to see and enjoy, and it is the evident intention to return the compliment here this fall. Every such gathering, whether on our own or on foreign soil, has a direct and strong tendency to break down prejudice, and make our relations with other countries more pleasant and cordial, and is, therefore, a cause of congratulation. We shall hope that nothing will occur to mar the pleasure of the occasion, and that our guests will enjoy themselves so well that other similar visits will be assured for the future.

A New Method of Encouraging Manufactures.

It might be well for some of the towns which are considering means of attracting manufactures to look into an idea which has recently taken form in Hartford, Conn. A company has been formed there, called the Board of Trade Room and Power Company, prominent and influential citizens taking an active part in the matter, and they have purchased a tract of land on which they propose to erect a building suitable for the accommodation of a number of small manufacturing enterprises. The building will be first-class in every particular, equipped with a power plant and tools, and will be divided into as many rooms as may seem advisable. The idea is to rent these rooms to inventors or mechanics who may have undeveloped ideas relating to machinery, at low rates, and to give them such other assistance as may seem advisable in a mechanical way. Such ideas as seem to be good will then be considered by the Board of Trade, and such action taken as may be deemed advisable to place the enterprise on a proper financial footing.

The men whose names appear in connection with this enterprise are those of well-known citizens of Hartford, many of them connected with the best known and most successful manufacturing establishments there, which gives assurance that its affairs will be well managed, and we can see no reason why this should not become a very successful and satisfactory thing. We have before called attention to the folly of discriminating in favor of large establishments in holding out inducements for the location of manufacturers, believing as we do that the town which can attract a number of smaller establishments is as well, and, in some respects, better off. The large manufacturers of Hartford, many of whom, connected with this new movement, themselves started in a small way, have shown a shrewd appreciation of this fact, and it seems to us have hit upon a most excellent plan to attract just the kind of men who will build up establishments of the most valuable kind. And having them there during the developing process will give good opportunities for acquaintances to be formed and correct estimates made as to the qualifications of experimenters for carrying on business enterprises or managing manufacturing establishments.

We have strong hopes that this will turn out to be an excellent thing for all who have to do with it, and that it will be the means of securing for many deserving mechanics and others a foothold in Hartford as manufacturers, which they might otherwise not have secured, to the advantage of them and of Hartford.

We don't know that the making of a machinist out of an ordinary man is apt to make trouble for anybody, but that such a transformation has led to considerable trouble in our new and gorgeous navy seems to be indicated by an account recently published in the newspapers, in which it is said that trouble was brought about on board the United States man-of-war "Charleston" by reducing the ship's electrician to the rank of "assistant machinist," whatever that may be; a proceeding which not only made the assistant-machinist—ex-ship's—electrician dissatisfied, but caused him to stir up trouble by showing the rest of the crew, who were neither ship's electricians, assistant machinists, nor anything but just sailors, that they were shamefully treated; kept below decks when not on duty and barred from the use of the library which the citizens of San Francisco had presented to them.

And their attention having been called to these things they almost unanimously deserted at Honolulu, and natives had to be hired to capture and return them to the ship. Machinists are not fond of red tape as a general thing, and if our naval officers want to avoid trouble they must do away with some of it or avoid making machinists out of electricians. If that man had been made a full-fledged machinist instead of a mere assistant machinist, there is no telling what he might have done.

But at any rate it seems to us that it is a good thing for the citizens of San Francisco to be thus made aware that the men are not allowed to use the library presented by them, and it would be in order for them to say whether or not they intended it solely for the use of the officers. There is, we believe, considerable complaint regarding the difficulty in getting good men, and especially American citizens, to enlist in the navy. Such little incidents go to show the cause of the difficulty, perhaps.

Literary Notes.

PRACTICAL DYNAMO-BUILDING FOR AMATEURS. HOW TO WIND FOR ANY OUTPUT. By Frederick Walker, Member of the Society of Civil and Mechanical Engineers. Van Nostrand Science Series. D. Van Nostrand Co., New York. Price 50c.

This book is intended to do just what its title indicates, and gives drawings and plain directions by which an amateur mechanic can construct a dynamo. It is not pretended that this dynamo, when finished, will be the best that it is possible to make, but that it will be as good as the facilities usually available by the amateur will admit of. The use of machine tools, and a fair groundwork in the theory of electricity, including Ohm's law, is premised by the author. The book is the first American from the second English edition.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(336) W. G. S., Boonton, N. J., asks: What should be the number of revolutions of the crank of a 4½"x11" engine; steam ports, 1¾"x⅝". *A.*—About 300 revolutions per minute will give good results. Your other question we do not understand. Please state it more plainly.

(337) T. W. M., Fulton, N. Y., writes: We have for some time been trying to get an iron, or mixture of iron, that will make small chilled rolls, but without satisfactory results. Can you help us? *A.*—We think you will find the information you want in the AMERICAN MACHINIST of July 10, 1886, and February 21, 1889.

(338) G. M. T., Williamstown, Mass., asks: Has an inventor a right to manufacture and sell an article for which he has applied for a patent in the United States? *A.*—Yes; but the articles should be marked "Patent applied for." 2. Has an inventor a right to use the word "Patented" before the patent is granted? *A.*—No; we cannot see how any person can expect to have a right to claim to have that which he has not.

(339) Inquirer, New York, asks: By what authority does a person affix the letters M. E. to his name? Is there a society of learning which gives such a degree, which I suppose is intended for mechanical engineer? *A.*—Technical institutes in which mechanical engineering is taught give to their graduates the right to affix M. E. to their names. There are quite a number of these institutes in this country. Stevens Institute, Hoboken, quite near to your home, is one of them.

(340) H. S. H., Cleveland, Ohio, writes: We have had quite an argument in regard to which is the driver in a street-car motor. We have decided to leave the question with you. *A.*—All wheels which receive motion

from the motive power are driving wheels. Those wheels which receive their motion direct from the motive power are generally called main drivers, and those which receive their motions by being coupled to the main drivers, either by side rods, gears or otherwise, are simply called drivers.

(341) I. B. W., New York, writes: Please inform me how I can set a slide valve so as to cut off square, and have $\frac{1}{16}$ of an inch lead at each end. *A.*—In the ordinary slide valve engines this cannot be done. The custom is to give the valve the required amount of lead, and let the cut-off take care of itself. But in *designing* a slide valve engine, equal lead and equal cut-off can be secured by introducing suitable rockers and connections. In this class of engines it is only necessary to set the valve to equal lead, and an equal cut-off will follow.

(342) S. W. C., Montreal, Canada, writes: I have a small upright engine, 2½x3 inches. I intend to put it into a boat 22 feet long, 5 feet beam. Please give me the draught of the boat, also the size of the boiler; I do not like a high boiler. *A.*—The draught of the boat will depend on the load it carries; the average draught will be about 20 inches. The best kind of boiler to use is a water tube boiler, of which there are a number on the market; but since all that are desirable to use are patented, you cannot make one yourself. We should therefore advise you to write to one of the makers of these boilers, who will furnish you with a boiler of the right size.

(343) J. R. G., Chicago, Ill., writes: Be kind enough to give me some information in regard to the method employed in preparing blue print paper and drying the same in a continuous roll. We are preparing large quantities of paper, and would like to know of some way to prevent the waste that occurs from cutting it into sheets. *A.*—Partition off a dark room for the purpose of drying the paper. Then prepare four or five feet of the paper at one time, and as fast as these portions are prepared pass them through a slot in the partition into the dark room, and let the paper dry on racks arranged for the purpose. The best time to prepare the paper is in the evening.

(344) K. M. S., Harriston, Canada, writes: Please give the proper way of equalizing the pressure on the crank-pin when the crank-pin is on the dead centers. Would it answer to give the valve more lead? Or would it be better to give it more exhaust lap? My engine is a 7″x10″ with a double-ported valve. How can I tell when the engine has the proper amount of compression? *A.*—We should give the engine a sufficient amount of lead to make it run smoothly, probably $\frac{1}{32}$ of an inch lead will be ample. The exhaust lap should be such as to give a compression equal to about ¾ of the initial pressure. For determining the amount of compression you will have to apply an indicator.

(345) M. H., ———, asks: Does a horizontal engine require more lead at one end than at the other? *A.*—No, not under ordinary conditions. 2. Does the crosshead of an engine stop longer at one end of its travel than at the other? *A.*—Some engineers claim that the crosshead does not stop at the ends of its travel. If, on the other hand, it is admitted that the crosshead does stop, it can only do so during an instant which cannot be measured; hence, it may be said that the crosshead does not stop longer at one end than at the other. 3. What is the best point of cut-off for a slide valve engine, with moderate load? *A.*—From ⅛ to ¼ of the stroke; we suppose you mean a plain slide valve engine.

(346) W. M., New York, writes: I am nineteen years of age, and have studied engineering and firing for the last six months. I know all about firing, feed pumps, injectors, steam boilers, etc. Please let me know where to apply to get a situation as fireman on a locomotive. Do you think I am old enough? and what wages do locomotive firemen receive. *A.*—Apply to one of the master mechanics of the road; if he does not hire the firemen he will direct you to the right person. The average pay of the firemen is from $1.75 to $2.00 per day. On some roads the pay is less, and on a few others it is a little more. In some States minors are not allowed to fire on a locomotive, but in New York State, we believe, your age will not hinder you from obtaining a position. After you have commenced firing on a locomotive you will find that there is still a great deal more to learn.

(347) J. S. G., Montreal, Canada, writes: I want to get your opinion as to whether a relief ring on the back of an Allen valve, arranged as follows, would give satisfaction. The relief ring is simply a hollow piston bearing against a straight surface on the back of the valve. The piston works in the steam chest cover, and is held against the valve by a spiral spring inserted between the piston and steam chest cover. Also state what would be the greatest area that the face of the piston could have, so as not to cause the valve to lift. *A.*—The objection to balancing a slide valve by means of a piston on your plan is that the working surfaces will not wear evenly. This method of balancing a valve is not new. The greatest area of the face of the piston should not exceed the area of the exhaust cavity in the face of the valve plus ⅛ to ¼ of the area of one steam port. Indeed, for a high steam pressure it is better not to allow the area of the piston to exceed that of the exhaust cavity in the face of the valve.

(348) T. M., Perry, Ill., writes: I have a traction engine for threshing wheat and grinding corn. I find that in lining the engine up, the main shaft is ⅛ of an inch below the center of the cylinder. Will that make any difference in the running of the engine? *A*—This difference in height of the shaft and cylinder will not affect the running of the engine to any appreciable degree, provided the engine is in alignment in every other respect. 2. Does the height of the smoke-stack make any difference in the draught when the exhaust steam passes through the stack? *A.*—The height of stack which probably is the most suitable for a forced draught, caused by the action of the exhaust, is about four times the diameter of the stack; a greater height does not seem to have a tendency to improve the draught. 3. Will the lowering of the exhaust nozzle give a stronger draught? *A.*—For the best draught, the distance from the top of the exhaust nozzle to the bottom of the stack should be equal to about the diameter of the stack in cases where the bottom of the stack is not enlarged; but in cases where the bottom of the stack is gradually enlarged, the exhaust nozzle can be placed somewhat closer.

(349) C. A. F., Lowell, Mass., writes: A. says that a wheel rolling on a track has a point on its rim that moves back of the center, B. says that it has no point on its rim that moves back, but that the center moves ahead. Which is right? *A.*—If A. means to say that a point on the rim moves in a horizontal direction opposite to that of the center, then A. is wrong, and B. is right. All points in the wheel, on its rim or otherwise, move in the same horizontal direction as that of the center, but the horizontal velocities of the points vary during one revolution. Take for instance a point at the bottom of the wheel, its horizontal velocity at that instant will be much slower than that of the center. When this point reaches the horizontal plane through the center then its horizontal velocity will be the same as that of the center; and at the instant that this same point reaches the top, its velocity will be much greater than that of the center. The consequence is that a given point, during one revolution, will at one time be in the rear, and at another time be in front of the center, but at all times it travels in the same horizontal direction as that of the center.

(350) J. P. P., Hartford, Conn., writes: Some time ago at one of Kellar's performances he illustrated a manner of proving an example in square root. I thought I had remembered it correctly, but it does not seem to work. As near as I can remember, the rule was to divide the sum of digits of the square and the root (separately) by nine, and if the root has been correctly extracted the remainder in each case will be the same. Can you correct me on this? *A*—We have not seen Mr. Kellar's method of proving the correctness of extracting the square root, and therefore we cannot correct you. 2. Can you tell me the decimal that gives the same result by multiplying as that obtained by dividing a number by 3.1416? *A.*—Divide 1 by 3.1416, the quotient will be the decimal required; it is .3183+. The quotient arising from dividing unity by any number is called the reciprocal of that number. The result obtained by multiplying a given quantity by the reciprocal of a given number is always the same as that obtained by dividing the given quantity by the given number. Hence if we wish to find the decimal that gives the same result by multiplying as that obtained by dividing a quantity by a number, we have only to find the reciprocal of the latter. For instance, dividing a quantity by 5 will give the same result as multiplying it by $\frac{1}{5} = .2$.

(351) M. E. C., Colfax, Wash., asks: 1. What is the best book on foundry practice? *A.*—"American Foundry Practice," by West, and "Molders' Text Book," by same author; "Spretson's Casting and Founding," and "Kirk's Founding of Metals," are all good books, and can be had of any publisher of mechanical and scientific books; you can probably order through your local bookseller. Your other questions have been referred to Mr. Simpson Bolland, who replies as follows: 2. Why is coke from gasworks unfit as fuel for melting iron? *A.*—Gas-house coke has not sufficient cohesive power to sustain the weight of iron above it, in consequence of which it crumbles, and much of the combustion takes place long before it reaches the melting point of the cupola, at which point it is always desirable to have the fuel compact and in good form to meet the full force of the blast. 3. How much coke is required to melt 100 pounds of iron in a 20″ cupola under favorable conditions? *A.*—Ten to fourteen pounds. 4. What can be used as a flux to keep the slag or something akin to it from mixing with the iron when it is poured into the molds and when skimming will not do it? *A.*—Better prevent the slag from entering the ladle; there would then be no necessity for the remedy. Some of the chief causes of slag are: Imperfect combustion, either from too much or too little blast; dirty iron; bottom and breast made up of material which is not of a sufficiently refractory nature; too much limestone or flux, etc. By giving strict attention to the remedying of the evils mentioned, and being careful to stop the flow of iron from the cupola before the slag appears, the ladles may be kept clean all through the heat.

(352) R. B. H., St. Paul, Minn., writes: The following was reported to me: An engine 8″x10″ running at 160 revolutions per minute had the speed increased to 310 revolutions per minute. At the latter speed, and with a load of 245 C. P. lights the engine would run quiet, but the crank and crosshead pins would heat in half an hour. The engineer claims to have prevented this by fastening a 24-pound weight to the crank end of the rod. Also when the engine was running at 310 revolutions with no load on, it would knock very hard. I have read several articles by eminent authors, but so far I have found nothing to corroborate the above. I should be glad to have your opinion. Does the adding of weight to the crank end of the connecting rod help to keep the crank-pin cool in a high-speed engine? *A.*—Before we can express an opinion on the case reported to you, we need to know more about the engine in question. On general principles we should say that the heating of a crank-pin or crosshead pin indicates that they are too small for the work they have to do, and we certainly should not attempt to avoid the heating by adding more weight to the connecting rod. As to the speed of the engines, experience seems to indicate that there is a certain speed at which the engine runs the smoothest, and this speed is generally greater than the speed for which the engine has been designed. We are, therefore, not surprised that the engine in question ran smoother at 310 revolutions than at 160 with the load on. Neither is it a matter of surprise to have the engine pound at the same high speed with no load on, because without the load, an earlier cut-off, or the throttling of the steam is required, which changes the whole condition under which the engine is working, and pounding will naturally follow. 2. What distance from the shell of a boiler 60 inches diameter should the bridge wall be? *A.*—The distance between the shell and the top of bridge wall should be such as to give an area for the gases to pass through equal to ½ of the grate surface. 3. Where can I obtain the best information about boiler setting? I have Wilson's, Rose, Armstrong's and the Hartford Boiler Insurance Co.'s plans. *A.*—We believe that you should be able to acquire from these authorities all the information that can be acquired from books. Experience also is necessary.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Friday morning for the ensuing week's issue.

Lexington Cut Iron Gears. See adv. on p. 20.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N.Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells & Co., 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Ice and Refrigerating Machines, 155 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N.Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Locomotive Driving-Box Planer Tool. Pedrick & Ayer, Philadelphia, Pa.

Special Tools for Railway Repair Shops. Pedrick & Ayer, Philadelphia, Pa.

Standard Tool Co.'s Twist Drills. S. A. Smith, 23 S. Canal st., Chicago, Western Representative.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

Get particulars of our new Wall, Suspended and Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

Audubon Machine Works, New Haven, Conn. Special machinery, heavy and light.

One Star Hack Saw will do as much work as five of any other kind.—N. B.

Curtis Pressure Regulators. Curtis Return Trap Curtis Damper Regulator. See August 7, p. 19. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N.Y.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal st., Chicago, Western Agent.

Horton's Chucks. We offer the balance of our stock at 50 per cent. discount. McFadden Co., Philadelphia, Pa.

"Roper's Hand-Books," for engineers and firemen. Send for descriptive catalogue. Address Edward Meeks, publisher, Philadelphia, Pa.

25″ Upright Drills a specialty. Finely made,
28″ great capacity, quickly operated, prices low.
32″ Send for list of firms using our Drills. J. E.
36″ Snyder, Worcester, Mass.

25″, 32″, 37″, 42″ "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

For Sale—Bound volumes of the Patent Office Gazette for years 1883, 1884, 1885, 1886, 1887 and 1888. Price, $4 per year. Address J. C., care of AMERICAN MACHINIST.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations, 8vo, cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting Rods for small connections. Especially adapted for Valve Rod for Steam Engines. T. C. Dill Machine Co., Philadelphia, Pa.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

MANUFACTURES

Barlow & Youmans will rebuild planing-mill at Galesburg, Mich.

A company has been organized at Wadesboro, N. C., to build a cotton factory.

It is reported that Mr. Mershon will erect a machine shop at Winchester, Ky.

The Burrows Shoe Company, of Portland, Me., are building a 65x210-feet factory.

Beard & Son, Greenville, S. C., will erect a foundry and machine shop at Spartanburg, S. C.

The Evans Land and Lumber Company expect to erect a hub and spoke factory at Ellijay, Ga.

Marble & McCurdy will erect a planing-mill and sash, door and blind factory at Bedford City, Va.

A 30-loom woolen-mill is to be built at Marshall, Tex., by the Marshall Manufacturing Association.

The Bibb Manufacturing Company of Macon, Ga., will erect a 100,000-dollar cotton-mill at Covington, Ga.

The Wadesboro (N. C.) Cotton-mills have been organized, with W. J. McLendon president, to erect a cotton-mill.

The Shelby (N. C.) Land and Improvement Company has been organized, and will erect electric light works.

The Cotton and Iron Works Company (Florence, Ala.,) is negotiating to put in some cotton factories on the creek.

The Commonwealth Cotton Manufacturing Company, Durham, N. C., has purchased a site, and will erect a factory there.

C. C. Stewart, of Brooklyn, N. Y., will probably make efforts to establish a woodworking machinery plant in Cordele, Ga.

The Fiberwood Company, of Livermore Falls, N. H., have voted to increase the capital stock to $75,000 and to extend the plant.

A large engine-house is being built at the Wampanoag Mill, Fall River, in which a 1,000 horse-power engine will be placed.

A company is being organized at Attleboro, Mass., for the manufacture of brass frames for tiles, moldings for stoves, etc.

The Jackson Fertilizer Company is erecting its new factory building at Jackson, Miss. The capital stock of the company is $30,000.

A stock company has been formed at Augusta, Ga., with a capital of $125,000, and work will begin on the erection of a flour-mill at once.

F. H. West is reported as organizing a stock company in Milwaukee, Wis., to establish a plumbers' hardware factory in Birmingham, Ala.

The North Chattanooga Manufacturing Company will, it is reported, erect works for the manufacture of mill machinery in North Chattanooga, Tenn.

Iron pipe works, a nail factory, passenger and electric car works, a foundry and machine shop are reported as to be established at Goshen Bridge, Va.

S. J. Tomlinson and R. T. Walker, of Lapeer, have organized the Michigan Lumber Co., and purchased the Wiener saw-mill, and will erect another at Wiener, Ark.

The Kennard Standard Counter Company has been organized at Saco, Me., with a capital of $100,000, for the manufacture of shoe counters and prepared shoe stock.

Carl Jenson, Reed Williams and others have purchased the old bolt and nut factory, and will establish a plow and agricultural implement factory at Birmingham, Ala.

A factory is being erected at Middlesboro, Ky., by the Middlesboro Mattress and Excelsior Manufacturing Company. It is to cost $50,000, and will be used for making excelsior.

J. A. George, recently reported as to erect a foundry and machine shop at Rome, Ga., has prepared plans for a three-story machine shop 60x100 feet, and a foundry 30x50 feet.

The Webster Paper Company is pushing work vigorously on the new paper-mill at Orono, Me. The plans call for a main mill 72x209, a finishing-room 52x120, and a boiler-house 40x50.

The latest catalogue of the Champion Blower and Forge Company, Lancaster, Pa., contains illustrations and descriptions of a variety of hand and power blowers, exhaust fans, forges, tire benders and shrinkers, drill presses, etc.

Caglins, of Allegheny, Pa., are to move their machine and foundry plant to Herr's Island region. They will put up a foundry 100x120, a three-story machine shop, 100x110, and a boiler shop, 50x110. Part will be ready in September.

The steel plant which the Norton Iron Works and the Kelly & Belfont Mills, of Ironton, Ohio, propose building at Ashland, Ky., will cost from $350,000 to $400,000. It is said that $100,000 of the capital stock has been subscribed in Ashland.

The Minnesota Iron Company is building a new machine shop at Tower, Minn. The machine department will be 80x40 feet, the blacksmith department 60x45 feet, and the carpenter department 72x45 feet, with solid fire walls separating them.

Simmons & Barnhill, of Bellaire, Ohio, have fitted their boiler shop with the necessary machinery and appliances for making converters for steel plants, and are now building a set for the Bellaire Steel Works, and another for the Wheeling Steel Works, at Benwood, W. Va.

Jefferson (Ohio) Iron Works will be rebuilt, and if the engines are in shape to repair, one nail factory can be started within a month. This factory has 81 machines in it, which, with the 79 machines in the factory that was burned, made a total of 160 that the company operated.

The Watertown Steam Engine Co., of Watertown, N. Y., is again finding the need of increased room. The present plant was built last year, but already additions are under way. The woodworking department is now being enlarged, and extensions of the foundry and boiler departments will follow.

The Vulcanized Fiber Co. (Wilmington, Del., and 14 Dey street, New York,) send us their catalogue explaining in part the uses made of vulcanized fiber, which is for a great variety of purposes for which metal is ordinarily employed. The catalogue is a good one for machinists and engineers to get and preserve.

The Steubenville Iron and Steel Company, which will move its plant from Alikanna, near Steubenville, Ohio, will be succeeded by a concern for the manufacture of hinges and bolts. A company has been formed in Steubenville to purchase the buildings of the iron works, after being dismantled, for the hinge factory.

The Salem Car and Machine Company has just been organized at Salem, Va., by capitalists from New York, Boston, Maine and New Hampshire. The authorized capital is $500,000. Work on the new plant will begin as soon as the formation details are completed. J. W. Allemong is president, and W. U. B. Stinson, of Concord, N. H., vice-president.

Brown & Mansur, of Houlton, Maine, are nearly ready to commence work in their new foundry and machine shop. Two large buildings and a brick boiler-house have been erected. When their establishment is completed they will have the best equipped and most complete outfit for manufacturing stoves, plows and machinery in Aroostook County, Maine.

The Richmond & Danville Railroad (office, Richmond, Va.,) intends building additional machine shops, and will probably locate one of them in Charlotte, N. C. The company has purchased a large tract of land, which is probably intended for a site. The erection of a new foundry and machine shop is projected. A. H. Lavell, Rome, Ga., can give particulars.

The Tennessee Spoke and Hub Company has been organized, with a capital of $30,000. It has purchased the Gallatin (Tenn.) Flouring Mill building, and will put in necessary machinery at once. The capacity will be two cars of spokes, one car of rims, one car of hubs a week. Dr. N. Morrow, Dr. J. D. Dismukes, of Nashville, Tenn., W. H. Brown, of Gallatin, Tenn., and others are interested.

D. H. & A. B. Tower, of Holyoke, Mass., are the architects of the pulp-mill to be built at Madison, Me., by the Manufacturing Investment Company. The capacity of the mill will be ten tons of pulp per day. An idea of the size of the mill may be gained from the fact that it is about half a mile around the foundations, and will require 351,000 feet of plank in the roofing, and upwards of 3,000,000 brick.

F. R. Pemberton, president of the Kensington Land Company, of Chattanooga, Tenn., which is building the new town of Kensington, claims that contracts have been signed for the erection of a 20,000 spindle cotton-mill, a rolling-mill, iron furnace, foundry and machine shops, and a handle and stave factory. He also states that negotiations are pending for a shoe factory, pipe works and another cotton factory, at Kensington, Ga.

Arrangements have been practically completed for the removal of the New Haven Wire Goods Company to Aurora, Ill., where they will be exempted from taxation for a number of years, and where a building is being erected for them. The company was organized in 1888, with a capital of $10,000, which has since been increased to $30,000, and at present employ seventy-five hands. A further increase of capital is probable in the new location.

The Springfield (Mass.) Foundry Company has recently started a new 80 horse-power engine in its works, and completed extensive improvements to the plant which were begun a year ago. Among the additions to the works are a three-story brick machine shop, 116x41 feet, with a two-story L 68x32, a two story brick building, 80x33 feet, a two-story addition to the iron foundry, 85x33, beside a new cupola-house, a cleaning-room, two core-ovens and a new brass foundry.

It is reported that another mill is to be added to the plant of the Globe Yarn Mills, Fall River, Mass. This company was incorporated in 1881, and at present has a capital of $900,000, and operates 84,000 spindles. It proved successful from the start, and has been steadily increasing its capacity as the demand for its product grew. Architects are already engaged on plans for the new mill. It is believed that the new mill will be of about half the capacity of Mill No. 3, and that work will be commenced on it at an early date. No meeting of stockholders has yet been held to authorize any increase of capital.

The Dominion Iron and Steel Company has been incorporated at St. John, N. B., with a capital stock of $500,000. The company is formed for the purpose of erecting and operating mills for the manufacture of rolled and hammered iron, bar iron, cut nails and spikes, horseshoes, railroad and other spikes, fish plates, polished shafting and other articles. The plant is to be built in the vicinity of the city of St. John, on the Bay of Fundy, accessible by vessel and adjacent to lines of railway that connect with all points east and west. The building will contain four train rolls, ten furnaces, nail and spike factory with fifty machines, a horseshoe machine, with a general machine shop and shafting department.

Col. E. H. Gilbert, of Ware, Mass., and about twelve other citizens have purchased the interest of the Thomson-Houston Company in the local electric light plant. The new company has made arrangements for the building of a large permanent electric light station on the ground formerly proposed by the Ware Power Company on land owned by the Central Massachusetts Railroad between the latter's freight house and the Ware River. The building will be of brick, 57x42 feet, and will contain a 650-light incandescent dynamo and a 50-arc light dynamo. The services of the present superintendent, George E Ballard, and his assistant will be retained, and the organization and perfection of a home rule electric-light company will be completed in a few days.

F. R. Hynes writes us: I have recently opened in this place a machine shop, and am prepared to do all kinds of jobbing and contract work in light machinery. Nothing but first-class machinery and tools will be used, and I intend making a specialty of a fine class of work. I shall engage in the regular manufacture of several specialties which will be placed on the market as soon as they can be completed and brought out. I am also open for engagement with parties having anything in light machinery or patented articles to manufacture on contract or otherwise. I am well located in a prosperous and growing town, which, by the way, would also be well worth the consideration of parties looking for location for any kind of manufacturing. Camden is one of the most desirable places in central New York, beautifully laid out, has an electric light plant, first-class railroad facilities, and absolutely the finest system of waterworks in this country, excepting *none*.

The following announcement is made: The Sterling Emery Wheel Company beg to announce that they have decided to move their emery wheel business from West Sterling, Mass., to Tiffin, Ohio. Negotiations for such a move have been in progress with different cities in the States of Ohio and Indiana for several months past. The location in Tiffin will be much more central than the present one, and more in the center of the larger consumers of the goods manufactured by the company, and at the same time we shall take advantage of the use of natural gas as a fuel, and thus several thousand dollars will be saved in this way each year. The Baltimore & Ohio, Pennsylvania, and Cincinnati, Sandusky & Cleveland Railroads, running through Tiffin, will furnish ample transportation facilities to all parts of the country. The trade in emery wheels has been constantly moving toward the West for the past five or ten years, and therefore this is the principal reason for this move being made. The company has been far behind in filling orders for the past year at their present location, and therefore much enlargement was deemed necessary. A brick building 200x60 is now ready for occupancy in Tiffin, where they expect at once to more than double the production of both the Sterling emery and corundum wheels. The New York warerooms (174 Fulton street) will, of course, be continued, but with a much enlarged stock.

Tools for Brass Work.

BY FRED H. COLVIN.

Continuing the subject of tools and machines for brass work, the milling machine will be found of interest, and there seems to be need of discussion on this subject. The AMERICAN MACHINIST has from time to time illustrated and described many different forms of milling machines, and several writers have given us much valuable matter concerning the practical use of the same, but few, if any, ever attacked the brass side of the question, so it is upon this I will dwell.

Perhaps there is no better way of starting the subject in hand than by illustrating a little machine, or rather attachment for a speed lathe, that has been in service for over seven years, with excellent results, has turned out the best milling it has ever been my good fortune to see, and from which most of my observations have been made, and conclusions drawn.

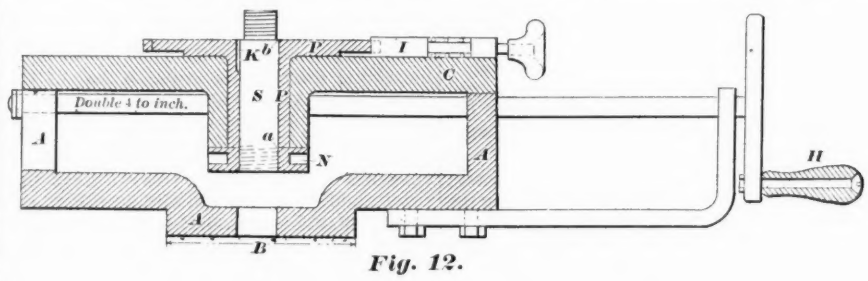


Fig. 12.

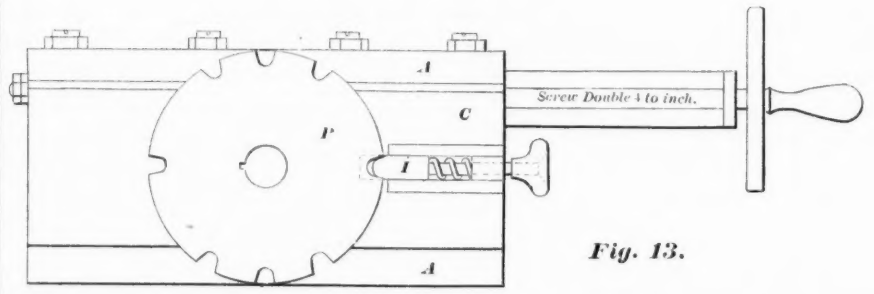


Fig. 13.

Fig. 12 shows a longitudinal section of this attachment, and Fig. 13 a top view, the other view in Fig. 14 shows the back end, and, with a little explanation, ought to be perfectly plain. The body *A* is planed to fit the lathe bed at *B*, and fastened thereto by a bolt through hole, and strap across the bottom of lathe bed.

The carriage *C* is planed to move in the body *A* on dovetail ways, and kept snug by gib and set-screws, as shown in Figs. 13 and 14, the back end of bed being left open to allow the central projection of the carriage to pass through, as shown by Fig. 14.

The index plate *P* (in most cases) also forms the bottom or fastening plate for the work to be milled, as we shall see later. The

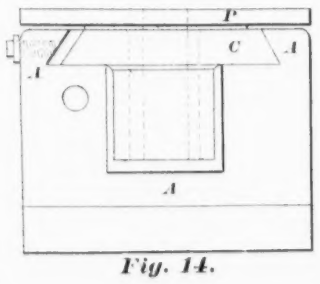


Fig. 14.

center spindle *S*, shown solid in the cut, is made of machine steel—both ends threaded as shown. The top fine (about a 12-thread) for the chucks, and the bottom coarser—6 to inch—for the binding nut *N*, besides having a key at the top *K*, which fits a groove in the bore of the index plate—allowing a vertical but not a rotary motion of spindle. The chuck being fastened on the upper end of spindle by the thread, and the work to be milled screwed on the chuck until its face is a little below the bottom of chuck (shown clearly in Fig. 22), the nut *N* being screwed up by pin wrench, as shown by the holes in nut, the spindle *S*, and the work on it, is drawn downward—fastening the work to plate, and locking the nut against the lower end of the plate. This being locked, the nut can only be turned by moving the whole plate, nut and all, and this is what it does, the plate bearing on top of the carriage, and the nut on the under side. By having these distances, *a* to *b*, exact in both cases, the plate can turn freely—and yet be firm and free from any detrimental vertical or side motion. The locking bolt *I* is plainly shown, and a glance at Fig. 13 shows the arrangement for square and hexagon milling, and no detail explanation is necessary. The movement is obtained by a screw, as shown, with a "double-four" thread, that seems to be fast enough for most purposes, though the pitch is immaterial, and can be altered to suit.

The screw is supported by the wrought-iron brace at the outer end, which gives the required steadiness, and the two check nuts at the back end hold it firmly as far as end play is concerned.

The handle *H* is worthy of attention, not from its novelty, but from its usefulness, it being much more agreeable to operate than the solid handle, and is appreciated by the men who run it, not only here, but on any machine, where practical. It is easily made, the spindle on which the handle revolves being a round head bolt with head slotted for screw-

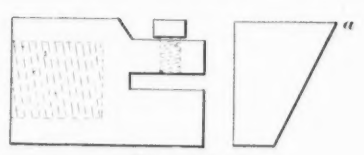


Fig. 15.

driver adjustment, is screwed through the wheel, and a thin lock nut holds it in position.

It is not intended to illustrate this as a model machine, but as a simple attachment by which good milling can be obtained, and it may act as a basis for the evolution of a standard milling machine for brass, although the principal defect in most milling machines that I have seen has been their cutters, and that can be easily remedied.

The cutter being the next question of importance, and in fact *the* important question, as it bears the same relation to good work as a lens does to a good picture with a camera. The cutter that will do the most work with the least grinding, and at least first cost, is the one that is looked for, and this our experience has shown to be the one shown with the holder or chuck in Fig. 15. The chuck is like any screw chuck, slotted across the face, and with set-screw as shown for holding cutter—a cheap and efficient method of holding an equally cheap and efficient cut-

ter. Fig. 16 shows how the cutters may be made from a flat bar of steel, in our case $\frac{3}{16}$x2 inches, though of course any size can be used.

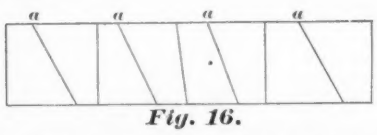


Fig. 16.

It will be seen that all of the back lines of cutter, *i. e.*, lines showing the back ends, are not square with the bar—this is done to get a lead on the cutter point, *i. e.*, have the point stand at a greater radius from the center of revolution; it is sometimes an advantage, though all work does not require it.

By making the angles the same as shown, the cuts made by the cutting chisel will give the right lead or clearance on the angular edge, so that little grinding is required; a little study of the cut—Fig. 16, will show my meaning.

In practice I cut the steel as shown, and break each piece off as cut, and then harden and temper just as they are—leaving the points for about half an inch rather hard, the rest soft, then a little grinding on the emery wheel, using plenty of water, makes them ready for work.

I usually make a dozen or so at a time, and the cost is trifling, compared with other forms. The secret of good work in this, as in many other things, is in having the tools just right, so if the cutter is ground just right good work is easily turned out, and the knack is easily acquired. For the benefit of any who may wish to try this form of cutter, let me offer a few suggestions, and start with a few facts to be borne in mind. First, the nearer square the corner *a*, Fig. 15—the less cutting surface you have to keep sharp—for the only cutting surface will be the distance on the top edge from *a* that the cut is in depth—the more this is rounded the more cutting surface you have to keep sharp. Some will claim that an advantage probably—dividing the work more—and will say they have seen some very nice work done with the corner *a* rounded on a quarter-inch radius—but for myself, and have had considerable experience with it—the cutter point as near square as possible suits me best. If it be left with a sharp corner, it will not cut smooth, as the point shows the rate of feed on the milled surface—but with just a trifle rounded off on the *grindstone* (emery wheel does to rough them down to shape with), and if need be smoothed with an oil stone, and you have a cutter that will cut well, last well, and give general satisfaction; to be sure it isn't as pretty a looking rig as I have seen, but it does the work, and that is all important.

Always give it all the sweep you can, and don't oil stone it to death, as I have seen

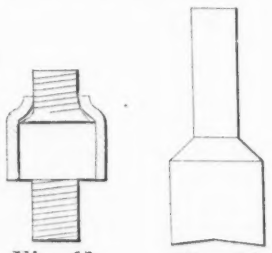


Fig. 17. *Fig. 18.*

done—it doesn't need the stone after every grinding, only when there is a sharp corner left somewhere. All work will not admit of this form of cutter, but wherever possible we use it, and find it best—for small work on chucks like Fig. 17, it will not work, as the cutter would cut away the loose collar shown in section around the chuck proper. So we use a cutter like Fig. 18, and find it very good indeed. This is simply a round shank that fits a screw chuck, and the cutting end flattened to width required; the points are worth attention, and it will be seen the center is ground hollow, so as to let the points project ahead, and this is the secret of good work with all cutters of this kind. The points do the work, and the center wants to be kept out of the way, and, like the other cutter, wants only enough rounded to produce a smooth surface.

Most milling machines are equipped with cutters like Fig. 19, which shows the front end of one in section—the center is usually drilled out and four cutting wings milled in the face. When new and square, these do nice work, but how long will they remain so? Not long, as every one knows who has seen them, and to grind them all square and even takes more than average steady man; in fact, I doubt if any one can get them perfect by hand—and, if not perfect, only one or possibly two of the wings cut; so the advantage of a number of teeth disappears when the difficulty of maintaining them is considered.

In the average case they assume the shape shown in Fig. 19, in an exaggerated form, and the work they then produce is a sight to be-

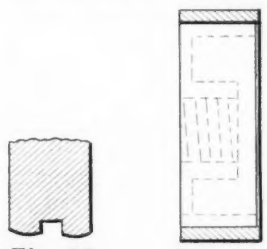


Fig. 19. *Fig. 20.*

hold. While from an artistic point of view the "snowflake" and "bas relief" effects these produce may be very fine—a mechanic knows that the nearer a perfectly smooth surface he can get, without scratch or mark of any kind, the better the milling and the better the tools used. A few of the chucks are shown in Figs. 17, 20, 21 and 22, and it will be noticed that Fig. 17 is made to fit a female spindle of the machine, which interchanges without any difficulty, and for small work, or work that must be brought low on the index plate, it is of great advantage.

It will be seen that, except in Fig. 21, all the chucks are supplied with loose collars that bind between the work and plate as the chuck proper, and work is drawn down by the spindle, as explained before.

We have tried the chucks where the work is screwed on or in, untils it jams tight

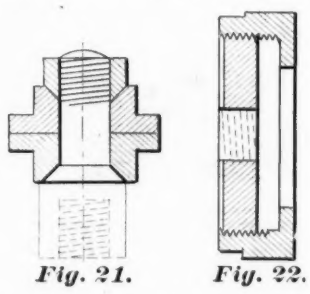


Fig. 21. *Fig. 22.*

enough to hold, but they are not satisfactory and should not recommend their use. Fig. 21 is a spindle chuck, and a coned nut locks the work against a coned base—centering it and holding it firmly enough for such small work as shown, and of the thin work shown, two or more may be milled at once. Fig. 20 is for inside work, as shown by dotted lines, and needs no explanation, save the fact that it draws down on the loose collar in a manner similar to the rest.

It is sometimes required to slot the ends of piping, tubes or similar articles, and Fig. 23 shows an attachment we have used for that purpose.

The construction of the frame *F* can be readily understood from the two cuts, and fastens to the moving carriage shown in the body of the milling machine, and, of course, moves with it.

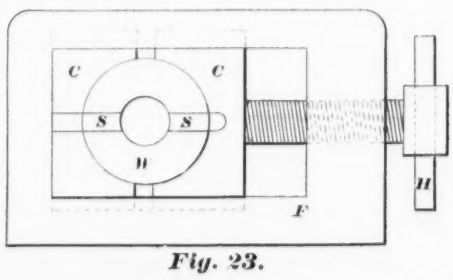


Fig. 23.

The work *W*, which we will suppose to be a brass tube that must be turned with a flat wrench or screw-driver. The jaws *C C* are of brass, and bored to fit the work, whether threaded or otherwise, the outside fitting the frame, and being held by a steel strap not shown in the cuts.

Insert the work and the screw shown will give the required friction, the handle *H* being an iron pin driven through a square-headed bolt. But we have been doing this without a cutter in place, so we will choose one from the next cut, Fig. 25; *b*, *c* and *d* show end views of different forms, while *a* is a side view of one that does fairly well, but has been abandoned for the others. It is a single point, ground so as to give all the clearance possible, but it has given way to a better one. The one shown at *b* is now used to some extent, being a round piece of steel, turned to fit holder, and the end turned the required size for slot and three grooves ground, filed or milled in, as the case may be, but *c* is now the most used, as it is cheaper, more easily ground, and does just as good work. The last one, *d*, needs no description, being, as shown, a triangular end view, and, while doing fairly good work, has given way to *c*, as have the rest of them—a case of "the survival of the fittest."

Many object to a single-point cutter, as shown in Fig 15, and prefer the two-point one shown in Fig. 18; but it may be interesting to state that I have seen one of these two-point cutters break one point completely off, and produce work exactly as good as before, the main requirement being that it shall be held as firmly as possible in the chuck, and

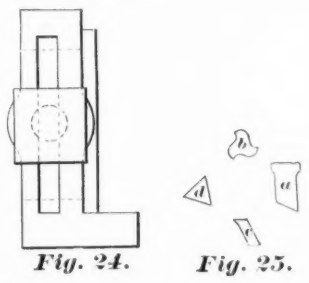


Fig. 24. *Fig. 25.*

no shake in the lathe spindle either. With a cutter like Fig. 18 I have milled fifty hexagon nuts, whose sides were about one-half a square inch each, with one grinding of the cutter, which seems to be a good record for the cutter, especially as the nuts were all milled to size, and milled smooth too, and feel safe in saying that I can show as good work from this little machine as any one can produce on any milling machine made.

For speed, a "double header" may excel it, though, where exact size is required, the extra time required to set two heads may reduce the speed attained more than its advocates will admit.

This seems to me an open question, a "double-headed" question, and I hardly know which side to favor—on general principles should favor anything that promised to increase the work produced, and as brass work as a rule—milling, I mean—usually consists in "taking off the rough," regardless of exact size—for this work the double machine is undoubtedly an advantage, while for exact work it seems that the single head would give less trouble. It will be noticed that the attachment shown has no means of vertical adjustment, which is, of course, a disadvantage, which can be overcome to a limited extent, by blocking up as required, with brass strips underneath, between lathe bed and bottom of machine.

A Cleveland press dispatch says:

There was a desperate battle Monday, at Continental Crossing, Putnam County, Ohio, between employes of the Clover Leaf Railroad and the village authorities. The village laid a sewer under the tracks, and a large force of railroad employes tore it up. In response to a telegram for assistance, Sheriff Williamson went to the scene of trouble with a posse of citizens and one company of militia.

In the fight that followed there were two hundred men on each side. Guns, revolvers, clubs and stones were freely used. About forty persons were hurt, but none fatally. The rioters were finally repulsed and the sewer recaptured. All is reported quiet to-night, though the rioters have made threatening demonstrations, and more trouble is feared.

The idea of railroad companies that they own the earth, instead of the right of way, is the cause of a good deal of trouble in this country. There is scarcely a city or town of any magnitude in the country that has not had more or less trouble in the effort to prevent some railroad company from appropriating land and in trespassing upon the rights of its citizens in the most boldfaced manner, and in the end the company usually gains its point, resorting to open warfare, and defying the city authorities to do so. The manner in which this has gone on is a shame to law and order. It is by such means as these that railroad corporations have secured the ill-will of the people in some States, until laws have been passed that are unjust to them. This is only a case of getting elevated by their own petard, and the verdict very generally is: Serves them right.

A daily paper in discussing the recent quick passages of the steamships Teutonic and City of New York has the following:

The reports of the race picture the firemen as shoveling into the Teutonic's furnaces ton after ton of coal, and when one relay of men had exhausted their strength another squad took their places.

This would be remarkable were it not for the fact that it is just what is always done on every transatlantic steamship, racer or not. It requires "ton after ton of coal" to take any of the liners across the Atlantic, and the force of firemen is never so great that they are not driven to the extreme of endurance. The "picture" is rather weak.

Sketches of an Apprenticeship.

BY W. S. ROGERS.

II.

It was some weeks later when I took my next important lesson in applied mechanics, and in the meantime I was busy cutting threads on two and three-inch wrought-iron pipe; that is, I turned the crank of the pipe machine, while the "jour." fed the oil with a spoon and took the credit of doing the work, looking for the "left-hand working wrench" they lost last week, helping the molder in the brass foundry "pour off" and "shake out," while occasionally I would try my hand in the sand, with a pattern, when he was absent.

I worried considerably too, because we had so much business on pipe work and brass valves, while no orders came in for blast furnace engines, or locomotives, and one day, when remarking on it to one of the fat, jolly jours, he rolled up his eyes in surprise, and said: "Build locomotives! Engines? with turret lathes? Oh, no, my boy you are in the wrong shop for that kind of work." Then as I gazed around on the dozen or more brass lathes and pipe-cutting and threading machines, a ray of light penetrated my skull, and I began to understand my boss's smooth ways. There are more ways than one for getting labor cheap.

One day I missed my oil can, containing cylinder oil, and started around the shop to find it. As the oil cans were nearly all made out of old tin cups, and fruit cans with a "nose" put in their tops with a pair of pliers, it was no easy task to find mine. At last I spied that precious can, over on the cock-grinding machine, and it was soon back in its proper place on the engine. After I had given the valve and piston a bountiful supply of its contents, a scraping noise from the engine-room soon called me back there, and I must say that engine had the worst attack of asthma I ever saw. I called the men in the shop to come and see, and the boss came also. He picked up the oil can, and gave it a dose of oil, which made matters worse, and the engine stopped. He stepped to the door and examined the oil can. Then I learned a lesson: that is, emery and oil must never be used to make machinery run quietly (unless you are building machine tools, and want to make the gears run quietly, then it is different, I suppose, or some builders would not do it.) Well, the boss got a new engine, and a new cub also, and thus ended my first attempt to become a machinist. But the moral I draw from that last lesson, and in after years, seeing a very noisy machine grow real quiet under the soothing influence of emery, is that there are tricks in all trades but ours.

So large a proportion of all the small engines made in this country are produced by those who make the agricultural engine, that the design adopted for them has an important influence on the whole. Alleged stupidity, slowness, and obtuseness with regard to things necessary to efficiency are characteristics which, whether real or imagined, are exercising a great and deterrent influence on the development of the small steam engine. It is not necessary that these characteristics should actually be operative. They are alleged to exist and to be operative, and that is in itself sufficient to produce the effect. The average owner and attendant of the small steam engines required on farms and estates are assumed to be incapable of exercising the care which is necessary to the proper working of an engine and boiler, if it be designed for economical working. Acting on this alleged stupidity and this assumed disregard by farmers of their own interests, the makers of engines and boilers of small power have been long accustomed to speak of an agricultural engine as though it were necessarily a thing of low order, capable of withstanding the roughest treatment, and of doing its work without the bestowal upon it of the least care. The consequence of this is that these small engines are made heavy and slow, and the boilers are made heavy and cumbersome, with large water space and small heating surface and low pressure.—*The Engineer* (London.)

A blower broke this morning on board the steamboat Sandy Hook, running between that point and this city. A blower is a fan with iron blades, which forces air down the air-shaft into the engine-room. When the iron blades began to bang and thump the sheet-iron sides of the air-shaft, the passengers on the lower deck looked at each other anxiously, and then rose and adjourned to the bow and stern of the boat with a breakneck speed and unanimity which were suggestive of a panic. One gentleman, who was having his boots blacked, stamped all over the kneeling Italian at his feet in his anxiety to get out of reach; and the passengers stretched on the sofas up-stairs, each of whom was taking up enough room for four, woke up and ran down the companion-way, only to be pushed back by those who were leaping up it. The excitement was over in a minute, and the white-faced young business men came back somewhat sheepishly to find an old gentleman, with his face as pale as his collar, saying, "Hoo—hoo—who's afraid? What are you running away for?"—*The Sun.*

There is an ordinance in New York, designed to make blasting safe. This ordinance specifies with a good deal of distinctness the quantity of timber with which a blast shall be covered, provides with perfect distinctness the 500 pounds of stone with which the timbers shall be weighted, but says nothing about the charge of powder—whether 1 pound or 100 pounds—that may be used. If the charge is large enough, it is rather evident that the 500 pounds of stone piled on the six timbers will be a source of danger, instead of otherwise—a charge of shot, as it were, top of the wad. It is no great wonder that so many accidents occur from careless blasting in New York.

The Convention of Factory Inspectors met in New York, Aug. 27. The inspectors were from nine States where factory inspection is legalized. Their objects are good, and such as ought to meet with all respect from the community. The delegates are opposed to baby work in factories, and believe that a restriction should be placed upon the hours which children should be employed. The factory inspectors have already accomplished a good deal, and the field is still wide.

A square link 12 in. broad, 1 in. thick, and about 12 ft. long was taken from the Kieff bridge, then forty years old, and tested in comparison with a similar link which had been preserved in the stock-house since the bridge was built. The following, from *Stahl und Eisen*, is the record of a mean of four longitudinal test pieces, 1 in. by 1⅛ in. by 8 in., taken from each link:—Tensile strength per square inch, tons, old link taken from bridge, 21.8; new link from storehouse, 22.2. Elastic limit per square inch, tons, old link, 11.1; new link, 11.9. Elongation, per cent., old link, 14.05; new link, 13.42. Contraction, per cent., old link, 17.35; new link, 18.75.

When contracts which have already been made are completed, more than one-third of the water supplied to the city of London will be pumped by Worthington pumps.

The London & Northwestern Railway carries employes and their wives for one-quarter fare, and their children for one-eighth fare.

Hereafter buildings in London must not exceed a height of 90 feet.

Machinists' Supplies and Iron.

NEW YORK, August 30, 1890.

Iron—American Pig For the best brands of foundry irons the demand has seemed to exceed the supply somewhat, and at times it has been difficult to obtain supplies. There has also been a moderate demand for other grades, and prices have generally been firmly maintained, though some slight concessions are reported to have been made on some inferior brands. The good demand for finished iron of all kinds still continues.

We quote Northern No. 1 Foundry, $17 to $18 No. 2, $16 to $17; Grey Forge, $15 to $15.25; Southern No. 1, $16.50 to $17.25; No. 1, Soft, $16.50 to $16.75; and No. 2, $15.75 to $16.

Scotch Pig—Though prices are higher in Glasgow, the demand here is for small lots only, and prices are not quotably higher.

We quote Eglinton, $19.25 to $19.75; Dalmellington, $21 to $21.50; Coltness, $23.50 to $24.

Bar—The demand has been moderately good, and prices are without quotable change.

We quote Common, $1.85; Medium, $1.90; Refined, $1.95 to $2 for round lots on dock.

Copper—The market has ruled quiet, but prices have been firmly maintained. Lake Ingot is sold at 17c. for both near and future deliveries; casting brands, 14½c.; Arizona, 15¼c. to 15½c.

Lead—The market has ruled quiet, but prices have been firmly maintained. Transactions have been confined mostly to small lots, with prices ranging from 4.70c. to 4.75c.

Spelter—The demand has been moderate, with prices firm. We quote ordinary brands, Western, 5.50c. to 5.60c.; choice, 5.70c. to 5.75c.; refined, 6¾c. to 7c.; Silesian, 7c. to 7½c.

Tin—Prices have advanced in London, and there has been some trading here at higher prices. Speculative influences are probably at the bottom of the movement. Values are at about 21.50c. to 21.85c.

Antimony—The demand for Regulus has been moderate, and prices somewhat irregular.

We quote: Hallett's, 19¾c. to 20c.; Cookson's, 23c.

Lard Oil—There is a steady demand for prime, and prices have advanced and are maintained at 52c.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Exp'd foreman for machine shop. Address, with particulars, W., 116 S. Clinton st., Chicago.

Wanted—Draftsman, engine work. Give age, experience, wages, and particulars. Morris County Machine & Iron Co., Dover, N. J.

Wanted—An exp'd molder as foreman of foundry employing 50 men on general and heavy machine castings. "Central New York," AM. MACHINIST.

Wanted—As foreman, an experienced and practical man in the manufacture of milled machine screws, etc., for shop in Canada. State salary; references required. Address Box 62, AM. MACHINIST.

Wanted—Good machinists; vise or machine hands; steady work and good wages to first-class men Address Frick Company, Waynesboro, Franklin Co., Pa.

Wanted—Superintendent for Architectural Iron Works with executive ability and experience. State reference and experience. A mechanical engineer preferred. Apply to S. H. Parvin's Sons, Cincinnati, O.

Wanted—First-class mechanical engineer, familiar with sheet rolling-mill machinery and furnace construction; state age, experience, salary, reference. Address Iron, 78 Jersey av., Jersey City, N. J.

Wanted—By a gentleman about to open a manufacturers' agency, correspondence with manfrs. desirous of being represented in Canada; security given. D. W. C., 307 Sherbourne street, Toronto, Canada.

Machinists Wanted—First-class floor hands and fitters of large experience and of good habits can find steady employment and liberal wages. Address Morgan Engineering Company, Alliance, O.

Wanted—A first-class tool maker that understands making stamping dies and screw machine tools. Good wages to a good man. Henry Haas & Son, 402 East 30th street, New York.

Wanted—Machinists and metal pattern makers; a steady employment given to capable men; works are being greatly enlarged; town near Chicago, is rapidly growing and has an excellent climate. Haxtun Steam Heater Co., Kewanee, Ill.

Wanted—Fifteen or twenty experienced molders, to make heavy and light castings; state experience, habits, age, and class of work preferred. Steady employment to good men. Address The Canton Steam Pump Co., Canton, Ohio.

Wanted—By young man, position as supt. or foreman of machine works; practical tool maker and machinist; thorough knowledge of Brown & Sharpe's grinders; used to close interchangeable work; best refs. Address Box 13, Simsbury, Conn.

BRADLEY HAMMERS AND FORGES

BEST HAMMERS IN THE WORLD RUN BY BELT

OVER 1500 IN USE.

Three Styles, 15 lb. to 500 lb. Heads.

Our FORGES heat irons fast enough to keep Hammers and Men fully employed. Send for Catalogue and Prices.

BRADLEY & CO., SYRACUSE, N. Y.

14 WARREN ST. NEW YORK. 96 & 98 SUDBURY ST. BOSTON.

BOILER MAKING

FOR BOILER MAKERS.

A practical treatise on work in the shop, showing the best methods of Riveting, Bracing, and Staying, Punching, Drilling, Smithing, Etc., and the most economical manner of obtaining the best quality of output at the least expense.

By W. H. FORD, M. E.

18mo, Cloth, - - - $1.00.

Published and For Sale by

JOHN WILEY & SONS, 53 E. 10th St, New York.

Mailed and prepaid on the receipt of the price.

ASBESTOS CEMENT FELTING,

FOR LAGGING LOCOMOTIVE BOILERS.

Samples and Descriptive Price List Free by Mail.

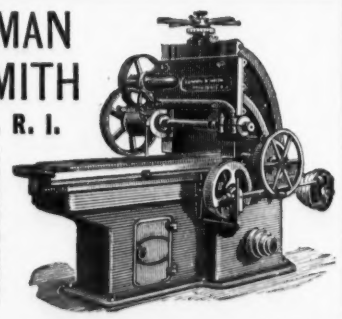
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.,

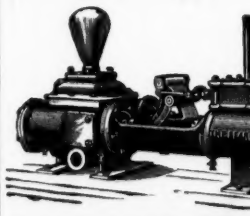
87 Maiden Lane, NEW YORK.

BEAMAN & SMITH

PROV. R. I.



HORIZONTAL SPINDLE MILLING MACHINE.



THE DEANE

OF HOLYOKE

STEAM PUMPS

DEANE STEAM PUMP CO.,

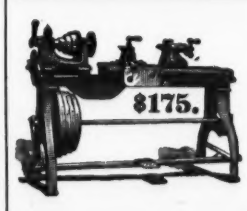
HOLYOKE, MASS.

THOSE WHO BUY

foreign brands of steel should not forget that while they have been perfecting their own tools we have not been standing still. Our Tool and Die Steel is second to none.

CRESCENT STEEL CO.,

64 & 66 SO. CLINTON ST., Chicago, Ills. | 136 FIRST AVENUE, Pittsburgh, Pa. | 480 PEARL STREET, New York, N. Y.



Improved Screw Cutting Foot and Power LATHES

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.

THE SEBASTIAN-MAY CO., 167 W. 2d St.,

CINCINNATI, O.

MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.

TOBIN BRONZE

Send for Circular.

Tensile Strength upwards of 79,000 lbs. per sq. in.
Torsional Strength equal to the best Machinery Steel.
Anti-Frictional and Non-Corrosive.

CAN BE FORGED HOT.

Rods for pumps and bolts. Yacht shafting. Rolled sheets and plates for pump linings and condenser tube sheets, &c. Spring wire.

ANSONIA BRASS & COPPER CO.,

Sole Manufacturers,

CHICAGO. NEW YORK.

CHARLES MURRAY

ENGRAVER ON WOOD

58 ANN ST. NEW YORK.

8,200 Copies of "PRAY'S BOOK,"

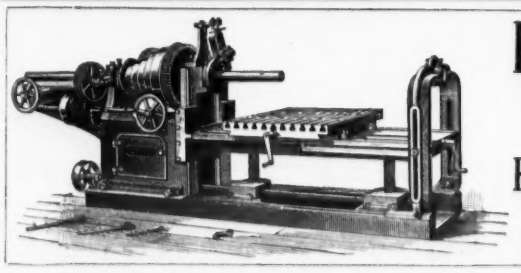
20 YEARS WITH INDICATOR

Sold to March 30th, 1890. Vols. 1 and 2 in one vol., $2.00.

JOHN WILEY & SONS, 53 E. 10th St., N. Y.

93 Liberty St., NEW YORK. | 113 Federal St., BOSTON.

IMPROVED PUMPING MACHINERY | For Every Class of Work. | Send for New Illustrated CATALOGUE.



BETTS MACHINE CO.

Wilmington, Del.

MAKERS OF

HEAVY MACHINE TOOLS

FROM

New Designs and Patterns.

Wanted—A foreman for Blacksmith and Hammer Dept's, at Pittsburgh Locomotive Works, Pittsburgh, Pa. Must be temperate and thoroughly understand the business. State wages expected, and address applications to the Company.

Wanted—Vise hands and fitters on turret lathe work Steady work to A1 workmen of good habits; new shop with modern tools and sanitary arrangements. Jones & Lamson Machine Co., Springfield, Vt.

Wanted immediately: One good designer and draftsman of practical exp. on metal-working machinery; also planer man, and two good scrapers and filers: we will give steady work to competent men. Fitchburg Machine Works, Fitchburg, Mass.

Wanted—Situation as master mechanic or foreman of a machine shop. Occupying a position as master mechanic at present. Understand steam engine and pump work, drawing, designing and estimating. Strictly temperate. Address C. W. Riley, Knoxville Car Wheel Co., Knoxville, Tenn.

Wanted—Superintendent to take charge of a small shop in England; must thoroughly understand manufacture of small lathes and milling machines on proper system. Good tools (American) and every facility. Permanent situation to really first-rate man. Apply with full particulars of experience and salary required, to Alfred Herbert, Grosvenor Road, Coventry, England.

Wanted—About 50 machinists of all branches. Wages for skilled men from 25 to 30 cents per hour, according to ability. Piece-work rates enable a good man to earn one-third more. Steady employment to reliable men. Shops exceptionally comfortable to work in. All workmen paid weekly. An Aid Society, fostered by the company, assists its employes in case of sickness or accident. This establishment in past years has furnished steadier employment to its workmen than any other in Western Pennsylvania. Good boarding at moderate rates will be provided for those who desire it, or are not acquainted in Pittsburgh. Further information may be obtained by calling at this company's agency in New York, 17 Cortlandt street, or by applying in person or by letter to The Westinghouse Machine Company, corner of Liberty and Twenty-fifth streets, Pittsburgh, Pa.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d-hd lathes & planers. S M York, Clev'd, O.

Koopman's Scales for quick measurements.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, Ohio.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Wanted—Customers for our new Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

Drawings for improved and labor-saving machinery a specialty. 252 Pearl st., N. Y. B. F. Bergh.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

For Sale—Old established paying foundry and machine shops; whole or half interest. Address L. M. Newbury, Sparta, Wis.

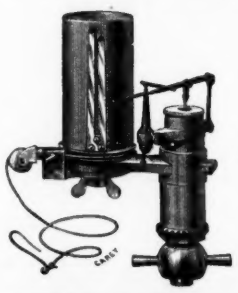
Wanted—To buy second-hand lathes, planers and shapers of all sizes. Must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

Wanted—Engineers to write for Catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

NICHOLSON FILE COMPANY,
PROVIDENCE, R. I.

FILES AND RASPS
FOR EVERY VARIETY OF WORK.

THOMPSON IMPROVED INDICATOR
MANUFACTURED SOLELY BY
American Steam Gauge Co.
5,000 IN USE.



Adopted by the U. S. Government for all the new Cruisers and Gunboats built for the Navy.
ALSO MANUFACTURERS OF
Pop Safety Valves, Steam Pressure Gauges, Etc.
No. 36 Chardon Street, BOSTON, MASS.
Send for Illustrated Catalogue Y free.

FRICTION
CLUTCH PULLEYS AND CUT-OFF COUPLINGS
JAS. HUNTER & SON, North Adams, Mass.

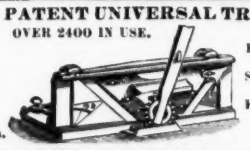
STANDARD OIL CUPS.
FOR ENGINES & DYNAMOS. HIGH SPEED MACHINERY.

A. J. WILKINSON & CO.,
184 Washington Street,
BOSTON, MASS.

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,
810 Walnut St., Philadelphia.

☞ Our New and Revised Catalogue of Practical and Scientific Books, 80 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

THE FOX PATENT UNIVERSAL TRIMMER
OVER 2400 IN USE.
ORIGINAL Saves Time, Three Sizes, Four Styles. IMPROVED Saves Money. From New Patterns.



NO PATTERN ROOM COMPLETE WITHOUT THEM.
Send for Circular. Beware of infringements.
THE FOX MACHINE CO., 325 North Front St., Grand Rapids, Mich.

SEND SAMPLE.
We make a specialty of all kinds of screw machine work and do it cheaper than you can.
WRITE FOR PRICES.
BLAUVELT & HALDY,
Factory, Pearl & Front Sts., Brooklyn. Office, No. 258 Broadway, N. Y.

REDUCED PRICES OF LECOUNT'S STRAIGHT TAIL DOG.

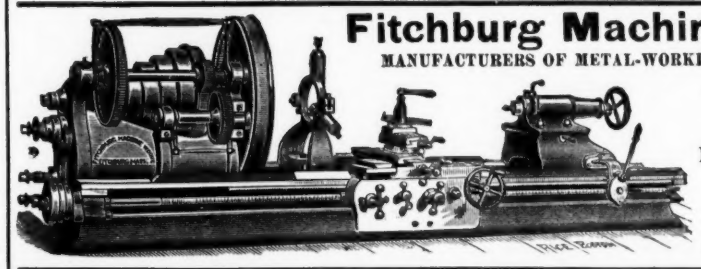
To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE.
1	¾	$0.60	10	2¼	$1.35
2	⅞	.70	11	2½	1.45
3	1	.70	12	3	1 60
4	1⅛	.80	13	3½	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4½	2.75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1.20	18	6	5.00
1 Set to 2 in.		7.80	Full Set		31.10

C. W. LeCOUNT, South Norwalk, Conn.

JESSOP'S STEEL
For TOOLS, DRILLS, DIES, &C.
All Kinds in Stock.
Gold Medal, Paris, 1889.
MANUFACTORY,
WILLIAM JESSOP & SONS, L'D. | SHEFFIELD, ENGLAND. | Chief American Office, 91 JOHN ST., NEW YORK.

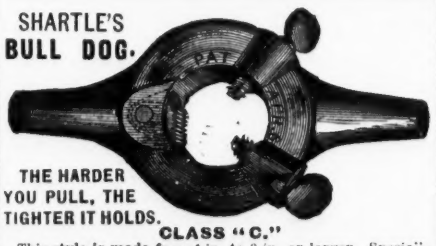
Fitchburg Machine Works
MANUFACTURERS OF METAL-WORKING MACHINERY.



OFFICE AND WORKS,
13 to 21
MAIN ST.,
Fitchburg, Mass.
SEND FOR CATALOGUE E.

PRATT INSTITUTE,
BROOKLYN, N. Y.
Day Classes will begin work September 17 and Evening Classes Sept. 26, in the Departments of Art, Domestic Science, Commerce and Music. Also in the
TECHNICAL HIGH SCHOOL DEPARTMENT.
A three years' course, for both sexes, combining Drawing and Manual Work with the usual studies of a High School or Academy. Entrance examinations will be held September 17 and 18.
DEPARTMENT OF MECHANIC ARTS AND BUILDING TRADES.
Carpentry; Turning; Blacksmithing; Machine Shop Work; Bricklaying; Plastering; Plumbing; Stone Carving and Cutting; House and Fresco Painting; Geometry; Chemistry; Electrical Construction; Applied Mechanics; Machine Design; Metallurgy of Iron and Steel; Steam.
For further information, or for application blanks, apply at the General Office of the Institute, Ryerson Street.
F. B. PRATT, SECRETARY.

SHARTLE'S BULL DOG.



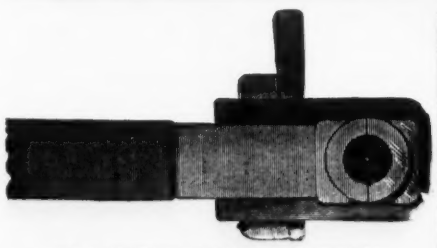
THE HARDER YOU PULL, THE TIGHTER IT HOLDS.
CLASS "C."
This style is made from 1 in. to 8 in. or larger. Specially adapted to axle and roll turning, and Boring Bars. Guaranteed not to slip. Write for catalogue showing the different styles.
MANUFACTURED BY
THE MIDDLETOWN MACHINE CO., Middletown, Ohio.

FOR SALE CHEAP.
One No. 10 STURTEVANT EXHAUST BLOWER, with 13 inch pulley, 11 inch face, 24 inch side, opening left hand. In use but a short time. Address
THE GREENWAY BREWING CO.,
SYRACUSE, N. Y.

STATIONARY
STEAM ENGINES
& BOILERS.
We have in stock, that we could ship within a few days from receipt of order, as follows:
Medium Speed Automatic Type:—1 left-hand, 55 horse-power; 1 right-hand, 75 horse-power; left-hand, 75 horse-power.
High Speed Automatic Type:—1 self-contained, center crank, 140 horse-power; 2 self-contained, center crank, each 18 horse-power.
Single Slide Valve Throttling Type: 1 right-hand, 16 horse-power.
Horizontal Tubular Boilers:—4, 12 horse-power; 2, 16 horse-power; 1, 55 horse-power.
Woodbury Engine Co.,
ROCHESTER, N. Y.

BUFFALO BLOWERS.
BUFFALO FORGE CO., BUFFALO, N. Y.

BRASS GOODS,
For Water, Steam and Gas. Brass and Composition
CASTINGS
to order. Pattern and Patent Brass Work a specialty.
W. S. WILLIAMSON,
36 to 40 Penn Street, BROOKLYN, N. Y.



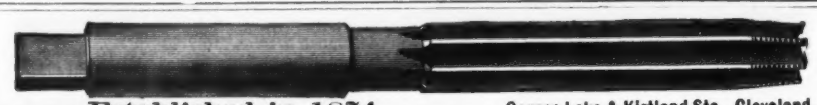
SAVE MONEY,
BY BUYING YOUR
STRAP JOINTS
FROM **COOKE & CO.,**
22 CORTLANDT STREET, NEW YORK
WRITE FOR PRICES,
Mentioning *American Machinist.*

Proposals for Steam Engine.
OHIO INSTITUTION FOR THE EDUCATION OF THE DEAF AND DUMB,
COLUMBUS, OHIO, August 20, 1890.
SEALED Proposals will be received at this office until 7 o'clock p. m.
Wednesday, the 17th day of September, 1890,
for one Stationary Steam Engine, 16 inch by 24 inch steam cylinder.
The trustees of said institution reserve the right to reject any or all proposals.
Envelopes containing proposals should be endorsed "Proposals for Steam Engine," and addressed to the undersigned.
SAMUEL A. KINNEAR,
Secretary.
A copy of printed instructions and specifications will be supplied upon application for same to Secretary or Prof. J. W. Knott, Superintendent, Columbus, Ohio.

THE BRITISH & EUROPEAN PATENT AGENCY,
F. W. BARKER, Manager, (Registered English Patent Agent, According to Act of Parliament,)
252 Broadway, New York.
151 Strand, London, Eng.
American and European Patents obtained at equitable rates. *Special Facilities for Sale of Foreign Patents through our London House. A good invention is worth as much in Great Britain as in the U. S.* Competent draftsmen employed on premises. We refer to well-known men in the machine trades for whom we have done business. Send for Circular.

"Star" Foot Lathe Swings 9x25 in. LATHE Screw Cutting Automatic Cross Feed, etc. Scroll Saws, Circular Saws, Lathes Mortisers. Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

WORTHINGTON
Independent Condenser
ONLY APPARATUS that can MAINTAIN a VACUUM on ENGINES and ELEVATE the discharge WATER to TANK at any height.
This feature is appreciated by PAPER MILLS SUGAR REFINERIES COTTON and WOOLEN MILLS
HENRY R WORTHINGTON
NEW YORK
BOSTON PHILADELPHIA CHICAGO
ST LOUIS ST PAUL SAN FRANCISCO

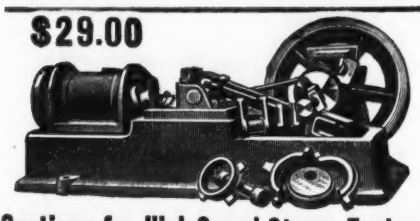


Established in 1874.

CLEVELAND TWIST DRILL CO.

Corner Lake & Kirtland Sts., Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.

$29.00



Castings for High Speed Steam Engine.

CYLINDER, 4 in. x 4 1-4 in.

T. SHRIVER & CO., IRON AND BRASS FOUNDERS,
333 E. 56th St., N. Y. City.

Sets of Castings for Engine illustrated above, with *Cast-steel Shaft, Connecting Rod* and *Rock Shaft* and *Brass Bearings*, boxed and shipped on receipt of $29.00. Three sheets *blue prints* of working drawings, extra.

VALLEY PUMP CO.,

EASTHAMPTON, MASS.

Single and Duplex. Also, Bucket Plunger, Acme, and A. B. C. Fly Wheel Pumps.

LANSDELL SYPHON

A Cheap & Simple Steam Pump.

Working by direct action of steam. Has no valves or other working parts, and cannot get out of repair, cannot freeze, and will pump ashes, waste, or anything that can enter the pipes. Invaluable as a bilge pump.

MADE IN LEAD OR BRASS FOR ACIDS.

J. S. LENG'S SON & CO.,
4 Fletcher Street, NEW YORK.

STEAM

PARK Double Jet INJECTOR

PARK MFG. CO.,
53 Portland Street,
Boston, Mass.

TO THE BOILER

WATER

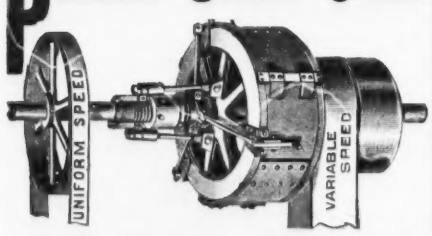
THE most reliable under varying steam pressure of any injector known. Will work from 15 pounds to 180 pounds without any adjustment. The only **Automatic Injector** that will thoroughly drain itself when shut off, thus preventing freezing. *Every Machine Guaranteed.*

INJECTORS AND JET APPARATUS.

DROP FORGING.

SPEIRS & MOORE, WORCESTER, MASS.

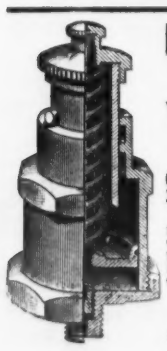
PERFECTLY UNIFORM SPEED!



The most irregular speed made perfectly uniform and regular. A change of over 30 per cent. can be obtained, while machine is in motion. Essential in all factories and mills and for driving dynamos. Makes power from water wheels, slow speed engines and electric motors absolutely regular and reliable.

Apply for information to

T. M. FOOTE REGULATOR CO.,
271 Franklin St., Boston, Mass.



LACKAWANNA GREASE CUP

Will Save Its Cost In Oil alone Several Times per Annum.

SAVES ALSO IN LABOR AND COST OF COTTON-WASTE, PREVENTS DRIPPING AND SPATTERING.

A POSITIVE FORCE FEED with the most PERFECT REGULATION and GREATEST CONVENIENCE in operation yet attained in any device for the lubrication of machinery. Works equally well in every possible position.

Lackawanna Lubricating Co.,
41 Coal Exchange, Scranton, Pa

SOME NOTABLE ARTICLES

APPEARING IN BACK ISSUES

OF THE

AMERICAN MACHINIST.

The following list is published to facilitate the ordering of back numbers containing them. Any of these issues can be ordered through any newsdealer, or of the publishers direct, at the price then ruling, viz.: 5 Cents a Copy.

1886.

Pattern Making, Various Articles on. By F. W. Barrows. Appearing in 29 issues.
Foundry Practice, Various Articles on. By Robt. E. Masters, appearing in 16 issues.
Strength of Different Mixtures of Cast-iron and Method of Testing. By Robt. E. Masters, April 24.
Foundry Practice, Articles on. By Foundryman. [L. C. Jewett.] Aug. 14, Sept. 25, Dec 18.
Foundry Practice, Articles on. By S. Bolland, May 8, 22 29, June 26 July 10.
The Morton-Poole Roll Grinding Lathe. By Joshua Rose, J. G. Tramis, Geo. H Babcock and C. A. Smith. July 3, 24, Aug. 7, 14, 21, Sept. 25.
Machine Shop Cost and Time Accounts. By A. J. Shaw, Henry Metcalfe and C. A. Burton, April 3, 17, May 8.
Tests of Iron. By David Spence, April 17, Oct. 30
Traction on Grades. By A. B. Ropes, Oct. 30.
Wilson's Valve Gear for Locomotives, Oct. 30.
Casting Face-plates Face Up. By David Spence, Oct. 23.
A Job of Shaft Straightening. By F. L. Johnson, Oct. 23.
Inventory Valuation of Machinery Plant. By Oberlin Smith, Aug. 7.
Making a Cast-iron Sheave. By P. S. Dingey, July 31.
New Dredge Boiler designed by Norman Wheeler, July 17.
Core Oven with Rotating Back. By Thos. Wathey, July 24.
Universal Table for Lathe Change Gears for Screw Cutting. By Joshua Rose, July 24.
Gating, Clamping and Securing Chaplets. By Matthew Wiard, May 1.
Printing Frame and Manner of Making Blue Prints. By C. L. Redfield, July 31.
Some Pressure Tests. By C. O Sine, Nov. 27.
An Expanding Mandrel—Turning Tapers. By Chas. S. Beach, Nov. 27.
Core Making in Foundries. By David Spence, Nov. 20.
Making Pattern for Spiral Grooved Drum. By Geo. Allge, Aug. 14.
Rolling Conic Sections Applied to Gears. By Geo B. Grant, Nov. 6.
Ninety-inch Belpaire Fire-box Boiler, Nov. 6.
Spacing in the Milling Machine. By Chas. S. Beach, Aug. 21.
Engine Crossheads. By J. G. Tramis, Aug. 21.
Traction and Adhesion. By A. B. Ropes, Aug. 28.
Internal Key-seating on Milling Machines. By A. B Landis, April 17.
Tapping Holes in Boilers. By A. B. Landis, April 24.
How to True Emery Wheels. By L Best, April 24.
Work and System in the Drawing-room. By C. L. Redfield, Aug. 28.
Oiling Lathe Carriage Ways. By Wm. H. Bradt, Aug. 28.
Moulding a Screw or Worm without Cores. By George Allge. Sept. 11, 18.
Power Absorbed in Cutting Cast-iron. By James F. Hobart. Sept. 11, 18.
Moulding Screw Propellers in Loam. By Chas. A. Devlin, Sept. 18.
Dimensions of Wrought iron Pipes in England. By A G. Brown, Sept 4.
Truing Up and Replacing Milling Machine Centers with Accurate Alignment. By A. B. Landis. Jan. 16.
Methods of Working and Tempering Steel. By S. W. Goodyear, Jan. 9.
Slotting Tool. By J. J. Bingley, May 8.
How to Make Clean Solid Castings at Least Possible Cost. By Matthew Wiard, April 10.
Truing Milling Machine Centers. By W. R. Ballou, April 10.
Lining Engine Lathes. By Chas. S. Beach, April 10.
Steam Piping. By J. G. Tramis, April 10.
An Equalizing Dog. By A. B. Landis, April 10.
Screw Cutting Dies. By John J. Grant, April 10.
Some Handy Shop Tools. By Fred. H. Colvin, April 3.
Moulding Bells for Blast Furnaces in Green Sand Without Patterns. By Geo. O. Vair, April 3.
Furnace for Heating Long Bars. By W. G. Richards, April 3.
Cutting Tools—Roll Turning. By S. W. Goodyear, Oct. 16.
Hydraulic Forging. By J. Richards, July 10.
A "Box" Jig. By C. E. Simonds, June 19.
Cheap Testing Machine. By Wm. Merrill, Feb. 6.
Boring Deep Holes. By A. B. Landis, Mar. 27 May 8.
Working Steel and Iron. By S. W. Goodyear, Feb. 13.
Inventory Valuations of Patterns. By W. E. Matheson and others, Jan. 9, Feb. 13, 20, Mar. 6.
Making Cast-iron Half Boxes. By A. J. Shaw, Feb. 6.
Draining Steam Pipes. By W. E. Crane. Feb. 6.
Brazing and Welding Iron. By J. F. Hobart, Mar. 6.
Deep Holes by Continuous Boring. By A. B. Landis, Mar. 27.
Slotting Machine Tool. By Wm. Foster, Mar. 20
Compound Engines for Stationary or Factory Purposes. By W. H. Hoffman, April 24, May 1, 22.
Engineering Subjects, Articles on. By W. H. Hoffman, Mar. 13, July 24, 31, Aug. 21, Oct. 9.
Self-contained Engines. By W. H. Hoffman, Feb. 27, Mar. 6.
Curving Qualities of Locomotives with High and Low Centers of Gravity, Oct. 16.
Making Large Spur Gear Wheels. By P. S. Dingey, Oct. 2.
Normal Theory of the Gear Tooth Curve. By Geo. B. Grant, Mar 13, 20. Oct. 9.
Return Tubular Boilers. By Wm. Lowe, Nov. 27, Dec. 4.
Chimneys for Steam Boilers. By Wm. Lowe, Mar. 27, May 15. By F. A. Halsey, May 1.
Railroad Cost Cards and Expense Sheets, April 24.
The Milling Machine—Its Construction and Uses. By John J. Grant, Mar. 20.
Mechanical Arrangements of the N. Hudson County Cable Railway, Mar. 20.

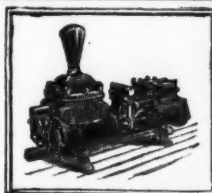
HALL DUPLEX STEAM PUMPS.

Send for 1890 Catalogue.

Fire Pump.

HALL STEAM PUMP CO.,
91 LIBERTY ST., NEW YORK.
PITTSBURGH. CHICAGO. ST. LOUIS.

Boiler and Pump Combined.

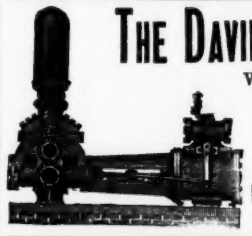


THE BUFFALO STEAM PUMP CO.
BUFFALO, N.Y. MANUFACTURERS OF
STEAM PUMPS
FOR ALL DUTIES.

Maslin's Patent Steam Pump.
Pat. Feb. 12, & Dec. 3, '89.

Cheapest and Best Automatic Steam Vacuum Pump. Handling DIRTY and GRITTY LIQUIDS without Wear, Oil or Care. Simple, Economical, Efficient & Durable. Pumping Plants for Contractors, Irrigation, Water Works, Railroads, Mining & General Hydraulic Purposes. Write or call for Circulars. JOHN MASLIN & SON, SOLE MANUF'RS, 165-167 1st St., Jersey City, N. J.

THE DAVIDSON STEAM PUMPS AND PUMPING ENGINES.



WARRANTED THE **BEST MADE** FOR ALL SITUATIONS.

Manufactured by

M. T. DAVIDSON.

PRINCIPAL OFFICE AND WORKS, 43-53 Keap St., Brooklyn, N. Y.

BRANCH OFFICES: 77 LIBERTY STREET, NEW YORK.
51 OLIVER STREET, BOSTON.

DUPLEX STEAM PUMPS.
POWER PUMPS.
PRESSURE PUMPS.
INDEPENDENT CONDENSING APPARATUS

BARR PUMPING ENGINE CO.

GERMANTOWN JUNCTION, PHILADELPHIA, PENNA.

CRUCIBLE AND OPEN HEARTH CAMERON SELF-HARDENING STEEL

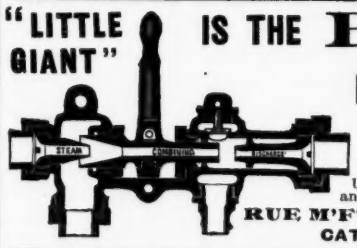
ESTABLISHED 1859.

HOWE, BROWN & CO., L't'd, Mfrs., Pittsburgh, Pa.

BRANCH OFFICES: 12 Cliff St., New York. 127 Oliver St., Boston. 228 Lake St., Chicago.

"LITTLE GIANT" IS THE Best Injector

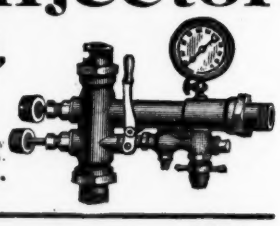
For Feeding all Steam Boilers.



RUE'S EJECTOR,

Superior to all others for Raising and Forcing Water and other Liquids.

Boiler Washer and Testing Device. Uses Warm Water, avoiding injury and facilitating the Raising of Steam.



RUE M'F'G CO., PHILA., PA.
CATALOGUES FREE.

REMOVES SCALE!

Engineers agree that our **Boiler Cleansing Compound** cannot be equalled

(LORD'S PATENT,)

for Removing and Preventing Scale in Steam Boilers.

Saves Fuel, Labor and Time, and prevents Corrosion in all its forms, and is guaranteed free from anything injurious to iron by the Chemists for United States Mint.

Engineers will receive free, on application, a 25-ct. book "HINTS FOR STEAM USERS."

BRANCHES: Baltimore, Md., New York, Pittsburgh, Pa., Chicago, Ill. and London, England.

S. W. Lord & Co., 11 So. 9th St., Philadelphia, Pa.

PREVENTS CORROSION!

PLANER VISES.

THE GILKERSON MACHINE CO.,
HOMER, N. Y.

THE KEYSTONE HANDLE.

A permanent and reliable method of attaching Hammers and all Edge Tools to Handles. Address,

E. H. BROOKS, LEBANON, PA.

UNIVERSAL RADIAL
RADIAL DRILLING MACHINES
THREE DESIGNS SIX SIZES
EMBODY ALL DESIRABLE FEATURES
PRICES $450.00 & UPWARD
ADDRESS UNIVERSAL RADIAL DRILL CO
CINCINNATI, O. U.S.A.

American Standard Gauge & Tool Works,
WILMINGTON, DEL.

Crescent Gauge.

Makers of Implements for Standard Measurements.

Over 43,900 in Use.

Flat Bar Gauge.

JAS. A. TAYLOR & CO.

STUBS PATTERN RIFFLERS NEEDLE FILES GROBET PATTERN STUBS
FILES
THE WORLD'S BEST

McFADDEN CO.,
735 MARKET ST., PHILADELPHIA.

Root's Force Blast Rotary Blower.

FOR

FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.

SLOW SPEED, POSITIVE BLAST, PERFECTLY BALANCED.

Best Mechanical Construction.

P. H. & F. M. ROOTS, Manufacturers,
CONNERSVILLE, IND.

S. S. TOWNSEND, Gen. Agt. } 22 Cortlandt St.,
COOKE & CO., Selling Agts. } NEW YORK.

In Writing Please Mention This Paper.

NO RIVETS EXPANDED TUBES CAULKED SEAMS PACKING NOR GASKETS **USED.**

For pamphlet describing construction and advantages of our boiler, address

HARRISON SAFETY BOILER WORKS,
Germantown Junction, Philadelphia, Pa.

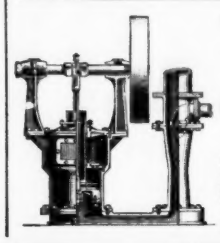
NEW YORK, N. Y. 41 Dey Street. | CHICAGO, ILL. 6 So. Canal Street. | ATLANTA, GA. 9 No. Pryor Street. | MINNEAPOLIS, MINN. 421 Guaranty Bldg.

THE LOWE BOILER.

The LOWE BOILERS with all Improvements have displaced about every kind of boiler in general use, and are now furnishing steam for about every purpose, and for every leading Cut-off Engine, and producing the highest economic effect from every fuel (oil included). The Engineers in charge of LOWE BOILERS say, that they furnish the dryest steam, evaporate the most water to the fuel, make steam the quickest, and retain the pressure the longest, with banked fires, and give the best results in economy of fuel, under both rapid and slow combustion of the fuel, and need the least repairs, of any boilers they ever had charge of. Send for description of the LOWE BOILER, and history of Steam Boilers (free) to the Sole Makers.

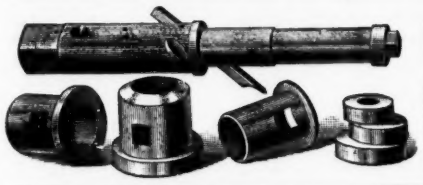
BRIDGEPORT BOILER WORKS,
BRIDGEPORT, CONN.

THOS. H. DALLETT & CO.
1305 Buttonwood Street,
PHILADELPHIA, PA.
Portable Drills,
Hand Drills,
Boiler Shell Drills,
Light Drill Presses,
Special Machinery.
SEND FOR CATALOGUE.



Belt Power Air Pump and Condenser.
CONOVER & CO.,
CONSULTING AND MECHANICAL ENGINEERS
95 LIBERTY ST.,
NEW YORK.
No Air Locks. 15 to 50 per cent. fuel saved or equal amount of power gained. Runs with same economy as engine. Adapted to all kinds of Engines. *Send for Circular.*

Steam Boilers
FOR ALL PURPOSES,
POND ENGINEERING CO.
St. Louis, Mo.
SEND FOR CIRCULAR.



—THE—
Vance Lightning Flue Cutter
For removing Flues from Locomotive and Stationary Boilers. One man can cut five hundred (one end) in a day. In use in the leading Railroad Shops of the country. Combination Cutter for removing 2 in., 2 1-4 in., 2 1-2 in. and 3 in. flues, $50. Sent on approval to Railroad Co's. Liberal Discounts to the Trade.
VANCE TUBE CUTTER CO., Geneva. N. Y.

SEND FOR CATALOGUE.
WORCESTER MACHINE SCREW CO.
WORCESTER, MASS.
Manufacturers of Set, Cap & Machine Screws, Studs, etc.

THE IXL DRAWING STAND
With or without board.
The best and most convenient Drawing Table in the world.
JONES & MACK,
Smith Bldg, 220 Walnut St., CINCINNATI, O.

Steel Balls from 1/16 inch to 2 1/8 inch for Anti-Friction Bearings a Specialty.
SEND FOR CATALOGUE.

SIMONDS PATENT PROCESS
SIMONDS ROLLING MACHINE CO.
TREASURER'S OFFICE 60 CONGRESS ST. BOSTON.
GEO. F. SIMONDS, PRESIDENT.
CHAUNCEY SMITH, VICE PRES'T.
EDWARD SAWYER, TREASURER.
JOHN J. GRANT, SUPERINTENDENT.
STEEL FORGINGS
by the SIMONDS patent process.
FITCHBURG, MASS. U.S.A.

CRUCIBLES
FROM 1/4 LB. TO 600 LBS. CAPACITY.
RETORTS. BOWLS. DIPPERS. STIRRERS. STOPPERS. COVERS.

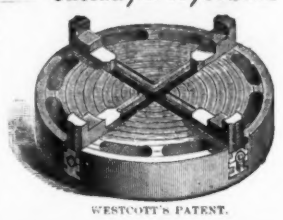
BLACK LEAD CRUCIBLES
MADE BY THE
JOS. DIXON CRUCIBLE CO., JERSEY CITY, N. J.
ARE THE STANDARD THE WORLD OVER, AND GUARANTEED THE BEST CRUCIBLES MADE.
CALL FOR DIXON'S BLACK LEAD CRUCIBLES, AND TAKE NO OTHER.

A FACT FOR YOU.
A large manufacturing firm, who had neglected the adoption of a Berryman Feed Water Heater and Purifier in their steam plant, were at last, owing to the cost of fuel, induced to put one in.
In less than a month they found a saving of over 30 tons of coal. This not only showed a great interest on the investment, but in a few months paid the whole cost of the heater.
BENJ. F. KELLEY & SON,
91 Liberty St., NEW YORK.
SPECIALISTS IN
Feed Water Heating & Purifying.

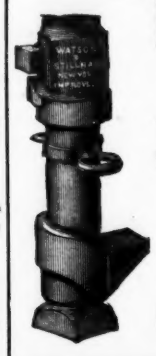
Westcott Chuck Co., Formerly **Oneida Steam Engine & Foundry Co.,** **Oneida, N.Y., U.S.A.**
Manufacturers of all kinds of
LATHE AND DRILL CHUCKS
SEND FOR **Illustrated Catalogue.**

SCROLL COMBINATION LATHE CHUCKS. BOTH 3 AND 4 JAW.

Diameter over all.	Will hold inside of Jaws.
4 9-16 in.	5 1-2 in.
6 in.	6 1-2 in.
7 1-2 in.	8 in.
10 1-8 in.	12 in.
13 1-4 in.	15 in.
16 in.	18 in.
18 1-2 in.	21 1-2 in.
21 1-4 in.	26 in.
24 in.	30 in.
30 in.	36 in.
36 in.	43 in.



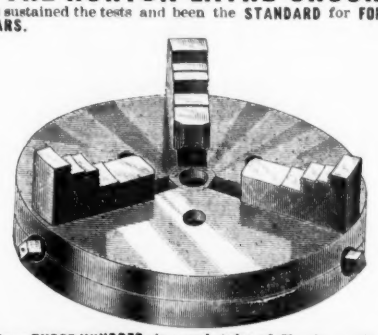
WESTCOTT'S PATENT.



Hydrostatic Machinery
PRESSES, PUMPS, PUNCHES,
ACCUMULATORS,
JACKS, VALVES, FITTINGS, &c., &c.
WATSON & STILLMAN,
204, 206, 208 & 210 E. 43d ST.,
NEW YORK.

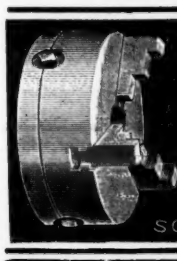
VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.

"THE HORTON LATHE CHUCK"
has sustained the tests and been the STANDARD for FORTY YEARS.



Over THREE HUNDRED sizes and styles of Chucks, made and kept in stock, by
THE E. HORTON & SON CO.,
WINDSOR LOCKS, CONN., U. S. A.
SEND FOR ILLUSTRATED PRICE LIST.

PATENT GEARED SCROLL CHUCK
UNEXCELLED FOR QUALITY, AND AS LOW IN PRICE AS ANY GEARED CHUCKS IN THE MARKET.
Made in NINE SIZES, from 2 INCH to 15 INCH INCLUSIVE.
SEND FOR NEW DESCRIPTIVE CATALOGUE
MANUFACTURED BY THE CUSHMAN CHUCK CO.
SOLD BY ALL DEALERS HARTFORD, CONN.



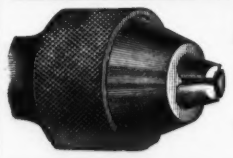
"THE SWEETLAND CHUCK"

NEW REVERSIBLE JAWS. SEND FOR CATALOGUE.

1884 PATENT CHUCKS.
We make a specialty of geared scroll chucks in diam's below 12". For many uses a scroll chuck cannot be excelled. Ask at your dealers for our 1884 Patent or write for our catalogue.
THE D. E. WHITON MACHINE CO.,
3 Oak St., NEW LONDON, CONN.
S. A. SMITH, 23 S. Canal St., Chicago, Western Agt.

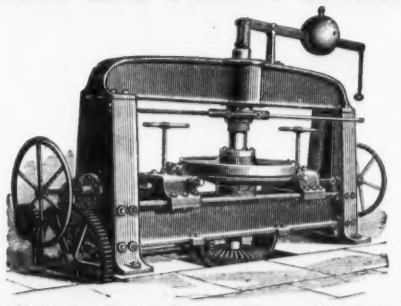
J. E. LONERGAN & CO.
211 Race St., Phila.
Manufacturers of
PATENT OILERS,
Cylinder Sight Feed Cups, Government Regulation
POP SAFETY VALVES
for Locomotive, Stationary and Marine Boilers, also the "Reliable" Steam Trap.
1888 Catalogue free on application.

Emery Wheel Tool Grinder.
55 Styles & Sizes.
SPRINGFIELD Emery Wheel Mfg. Co. Successors to Springfield Glue & Emery Wheel Co., Bridgeport, Conn. Western Branch, 18 and 20 West Randolph St. Chicago, Ill.
Guaranteed Satisfactory
WRITE FOR Ill's'd Circular No. D. Patented Sept. 25, 1883.
Water Prevents HEATING THE WORK.



Almond Drill Chuck.
Sold at all Machinists Supply Stores.
T. R. ALMOND,
83 & 85 Washington St.,
BROOKLYN, N. Y.

O'BRIEN'S PATENT BOILER HEAD FLANGING MACHINE.

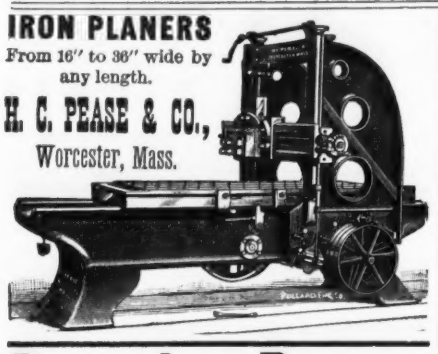


Rapid Work. Perfect Heads, with or without Dies. No Hole in Plate. Construction Simple. Price Reasonable.
JACOB CLARK, Mfr., Germantown, Philadelphia, Pa.

PATENT UNIVERSAL DEPTH ANGLE AND SCREW-CUTTING CENTER
J. WYKE & CO., TWIST DRILL GAUGE.
Fine Machinists' Tools.—E. Boston, Mass.—Send for Circular.

TOGGLE-JOINT DRAWING PRESSES. POWER SPRUE CUTTERS. ROTARY AND SQUARE SHEARS.
EMBOSSING PRESSES.
POWER PRESSES & DROP HAMMERS
FOR ALL KINDS OF SHEET AND BAR METAL.
DESIGNED AND BUILT BY
THE STILES & PARKER PRESS CO.,
MIDDLETOWN, CONN. 203-207 CENTRE ST., N. Y.
SPECIAL MACHINERY, DIES, TOOLS, ETC., ETC., MADE TO ORDER.
BUTTON TOOLS.

IRON PLANERS
From 16″ to 36″ wide by any length.
H. C. PEASE & CO.,
Worcester, Mass.

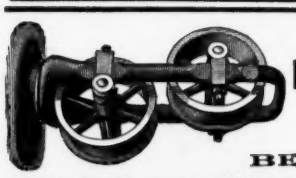


Pease Iron Planers,
All Sizes from 16 in.x16 in.x4 ft. to 36 in. x36 in.x12 ft. inclusive carried in stock.
HILL, CLARKE & CO.,
156 OLIVER ST., BOSTON, MASS.

Machinists' Fine Tools
STANDARD TOOL CO., ATHOL, MASS.
SEND FOR NEW CATALOGUE

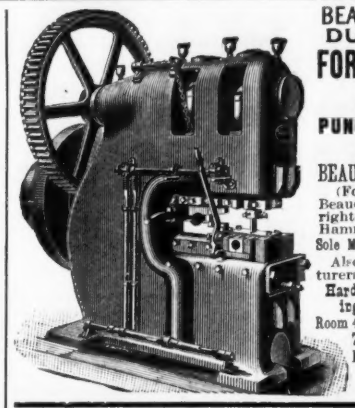
ALUMINUM $2 PER POUND.

THE PITTSBURGH REDUCTION COMPANY,
95 Fifth Avenue, Pittsburgh, Pa., U. S. A., offer commercially pure aluminum at the following rates at Pittsburgh, Pa.:
Lots of 1,000 lbs. and over.....$2.00 ℔ lb
Lots of 500 lbs. and over..... 2.25 ℔ lb
Lots of 100 lbs. and over..... 2.50 ℔ lb
Metal guaranteed to be equal in quality to the best metal manufactured by any other process.
Prices on sheets, wire, tubes or castings, given upon application.



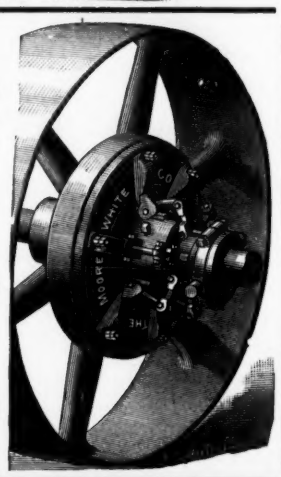
GUIDE PULLEYS FOR LIGHT BELTS.
JOHN ROYLE & SONS, PATERSON, N. J.

PRESSES, DIES AND SPECIAL
SHEET-METAL TOOLS
FERRACUTE MACHINE CO. BRIDGETON, N. J. U.S.A.



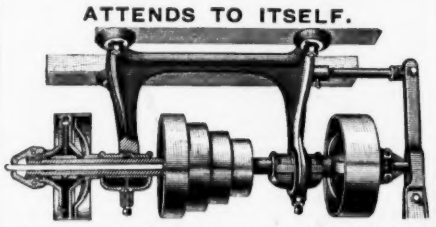
BEAUDRY'S DUPLEX
FORGING PRESS,
PUNCH AND SHEARS.
BEAUDRY & CO.
(Formerly of Beaudry's Upright Power Hammer.)
Sole Manufacturers.
Also Manufacturers of Hard Coal Heating Forges.
Room 4, Mason B'dg. 70 Kilby St., Boston, Mass.

THE MOORE & WHITE CO.,
Philadelphia, Pa.
Friction Clutch Pulleys, Cut-off Couplings, &c.



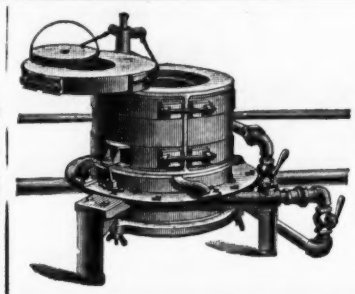
W. C. YOUNG & CO., Worcester, Mass. Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, ETC.

ATTENDS TO ITSELF.



A new Countershaft self-oiling for six months with self oiling loose pulleys, new and perfect friction clutch. Please send for circulars.
THE STATES MACHINE CO.
R. R. Place & Commerce St., Newark, N. J.

FRISBIE FRICTION PULLEYS AND CLUTCHES.
THE D. FRISBIE CO.,
114 LIBERTY STREET, - NEW YORK



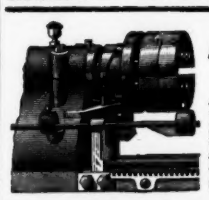
AMERICAN GAS FURNACE CO.,
DESIGNERS AND MANUFACTURERS
GAS BLAST FURNACES.
Send for Catalogue. Estimates made for any mechanical operation requiring **high, even** and **controllable temperature.**
No. 80 NASSAU ST.,
NEW YORK.

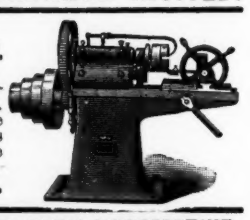
FINE TAPS, DIES, REAMERS, ETC.

LIGHTNING AND GREEN RIVER SCREW PLATES.
Bolt Cutters, Hand and Power Drilling Machines, Punching Presses, Tire Benders, Tire Upsetters and Other Labor-Saving Tools. Send for Price List.
WILEY & RUSSELL MFG. CO., GREENFIELD, MASS.

HEAVY AND LIGHT **CASTINGS** IRON OR BRASS
ARTHUR R. KING FOUNDRY & MACHINE WORKS,
ERIE, 11th & 12th STS., JERSEY CITY, N. J.
GENERAL MACHINE WORK. CORRESPONDENCE INVITED.

ADAMS
Automatic Bolt-Threading & Nut Tapping Machine.
Made in all Sizes to Cut from 1-4″ to 6″.
The simplest and most durable machine in existence. The threading head is made entirely of steel. No links, levers, springs, caps, cases, blocks or die rings in or about the head. Separate Heads and Dies Furnished. Write for descriptive circular and price list to
Capitol Mfg. Co., 125 to 137 Rees St., Chicago, Ill., U. S. A.





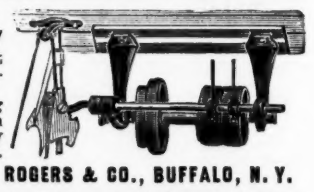
"PRACTICAL DRAWING."
By J. G. A. MEYER.
This valuable series of 93 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies, 5 cts. each, postpaid.

Order now before our stock of papers is exhausted.
ADDRESS:
American Machinist,
96 FULTON ST.,
NEW YORK.

"MODERN LOCOMOTIVE CONSTRUCTION."
By J. G. A. MEYER.
This valuable series of 106 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $5.30, or single copies, 5 cts. each, postpaid.

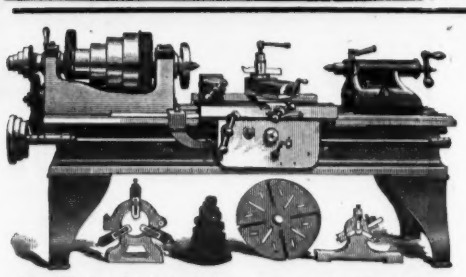
THE PECK PATENT DROP PRESS
MINER & PECK MF'G CO.
SUCCESSORS TO BEECHER & PECK
NEW HAVEN, CONN.
DROP FORGINGS

One Pull One Way
to either start or stop machine.
Self-locking belt and clutch shifter; fits any bar now in use.

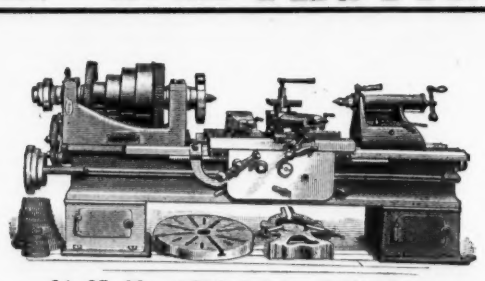


SAMUEL C. ROGERS & CO., BUFFALO, N. Y.

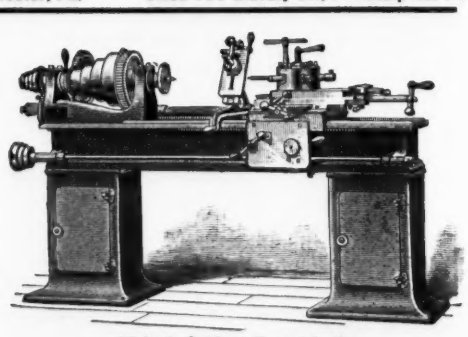
STEEL CASTINGS
FROM 1-4 TO 15,000 LBS. WEIGHT.
True to pattern, sound, solid, free from blow-holes and of unequaled strength.
Stronger and more durable than iron forgings in any position or for any service whatever.
60,000 CRANK SHAFTS and 50,000 GEAR WHEELS of this steel now running prove this.
Crossheads, Rockers, Piston-Heads, etc., for Locomotives.
STEEL CASTINGS of every description.
Send for Circulars and prices to
CHESTER STEEL CASTINGS CO.,
Works, Chester, Pa. Office 407 Library St., Philadelphia, Pa



17, 19 and 21-inch Swing Large Hollow Spindle.
Taper Attachment, Automatic Stop, Compound Rest, Lead Screw under front V. All feeds reversed in apron. Extra heavy, Convenient, and easily handled.



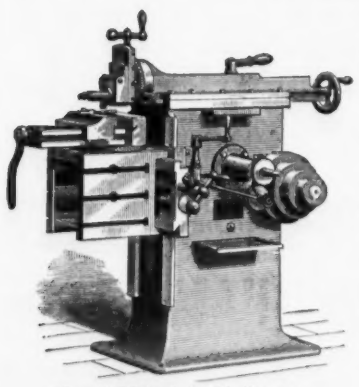
24, 27, 32 and 38-inch Swing, Cabinet Legs.



18-inch Cabinet Turret Lathe.
Taper Attachment, Automatic Feed, Lever and Screw Movement, most complete brass lathe on the market.

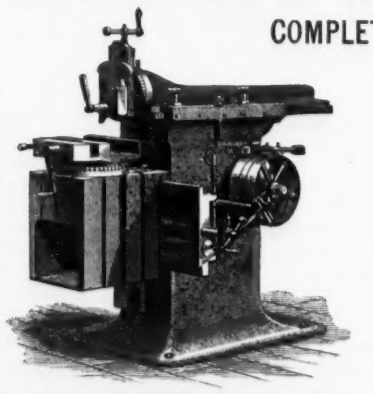
THE LODGE AND DAVIS MACHINE TOOL CO.
Works, CINCINNATI, OHIO.
EASTERN HOUSE,
64 Cortlandt Street, New York.
WESTERN HOUSE,
68 & 70 S. Canal Street, Chicago.

COMPLETE MACHINE SHOP EQUIPMENTS A SPECIALTY.

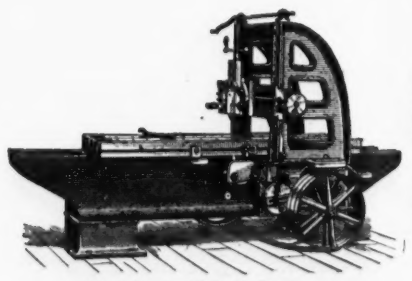


15 and 20-inch Crank Shaper.
Stroke changed and adjusted while running. Stroke at all times positive.
Invariably plane to a line.
Detachable Tables.

ENGINE LATHES
TURRET LATHES
IRON PLANERS
PULLEY LATHES

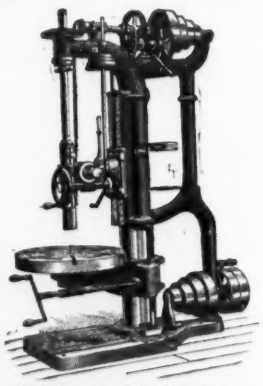


20, 26 and 32-inch Triple Geared Shapers.
Stroke changed while machine is running. Shaft can be passed through head of machine and key seat cut in same to any length. Extra heavy vises. Tables slotted on all sides.



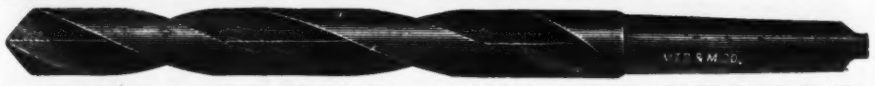
24, 32 and 36-inch Planers.
Extra deep beds and tables. Powerfully geared. Plenty of Metal and designed for extra heavy duty. All Feeds and Shipper operated from both sides.
Improved Device for holding Planer Bolts.

DRILL PRESSES
MILLING MACHINES
IRON SHAPERS

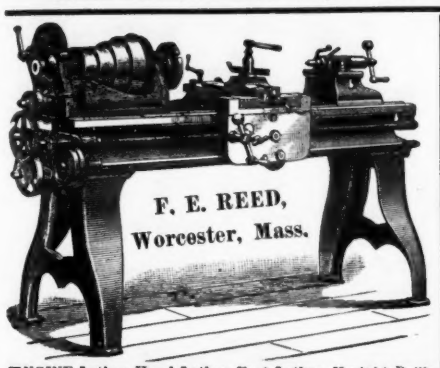


25, 28, 32 and 40-inch Drills.
Automatic stop to feed. Quick return on right side. Table operated from front. Large cones and long belts.

MORSE TWIST DRILL AND MACHINE COMPANY, New Bedford, Mass.
Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.**



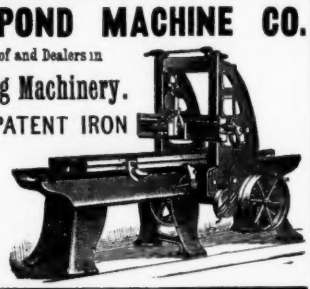
Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.



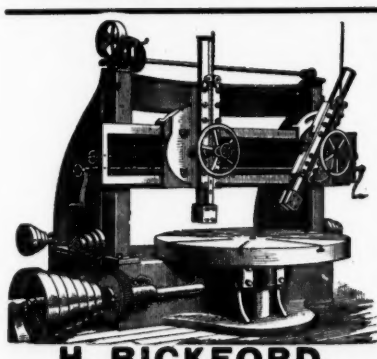
ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills and Milling Machines. Agents, MANNING, MAXWELL & MOORE, 111 LIBERTY STREET, NEW YORK.

FLATHER ENGINE LATHES
14, 15, 16, 18, 20, 24 and 28 INCH SWING.
ANY LENGTH OF BED UP TO 22 FEET.
HILL, CLARKE & CO.,
General Selling Agents,
156 OLIVER ST., BOSTON, MASS.

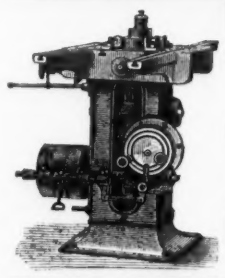
L. W. POND MACHINE CO.
Manufacturers of and Dealers in
Iron Working Machinery.
IMPROVED PATENT IRON PLANERS A SPECIALTY.
152 Union St., WORCESTER, MASS.



LARGE IRON PLANERS
QUICK DELIVERY. LOW PRICES.
SEND FOR SEPTEMBER DELIVERY SHEET.
HILL, CLARKE & CO.,
156 Oliver Street, Boston, Mass.

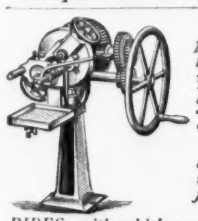


BORING AND TURNING MILLS, 4, 5 and 6 Ft. SWING.
H. BICKFORD,
LAKE VILLAGE N. H.



KEY SEATERS
PORTABLE AND STATIONARY.
RACK-CUTTING AND KEY-MAKING ATTACHMENTS.
Giant Key-Seater Co.,
EAST SAGINAW, MICH.

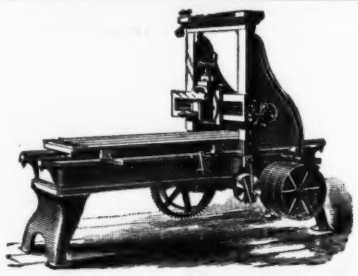
"Eclipse" Hand Pipe-Cutting Machines.



No. 1.—Powerful, inexpensive, simple in construction. Cuts and screws pipes ¼ to 2-inch. Easily carried about.

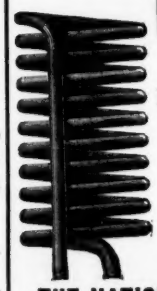
"ECLIPSE" Nos. 2 and 3. These are powerful and most efficient machines for cutting large PIPES, with which one man can easily cut off and thread 6-inch pipe.
No. 2 Cuts and Screws 2½ to 4 in.
No. 3 " " " 2½ to 6 in.
It will pay you to write us for particulars.
PANCOAST & MAULE, Philadelphia.
(Mention this paper.)
We also build Power Machines.

CARY & MOEN CO.
STEEL WIRE OF EVERY DESCRIPTION
EVERY DESCRIPTION OF STEEL SPRINGS.



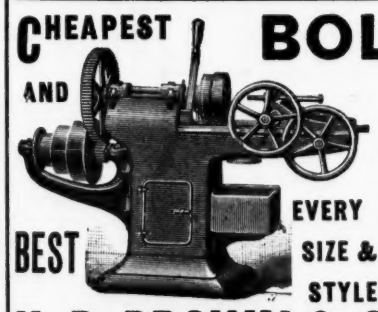
New Haven Manf'g Co.,
NEW HAVEN, CONN.
IRON-WORKING MACHINERY.

JUST OUT.
OUR NEW ILLUSTRATED CATALOGUE OF
Turret Machinery.
MANY NEW FEATURES.
JONES & LAMSON MACHINE CO.,
SPRINGFIELD, VERMONT.
SEND FOR IT.



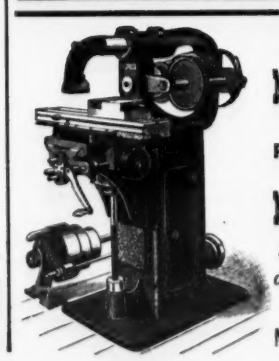
COILS & BENDS
—OF—
IRON, BRASS and COPPER
PIPE.
ALL STYLES.
THE NATIONAL PIPE BENDING CO.,
82 River Street, NEW HAVEN, CONN.

CHEAPEST AND BEST BOLT CUTTERS.

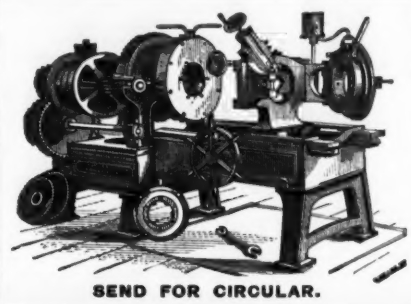


EVERY SIZE & STYLE.
H. B. BROWN & CO.,
EAST HAMPTON, CT.

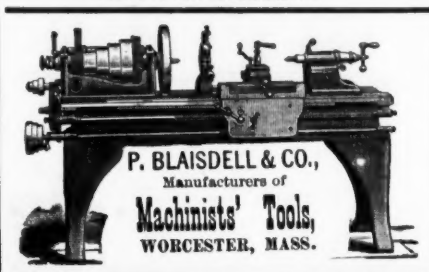
MACHINERY
For Reducing and Pointing Wire.
ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.
For Machines or Information, address the Manufacturer,
S. W. GOODYEAR, Waterbury, Ct.



KEMPSMITH Machine Tool Co.,
Manufacturers of
PLAIN AND UNIVERSAL
Milling Machines,
Of Modern Design and Superior Workmanship.
MILWAUKEE, WIS.

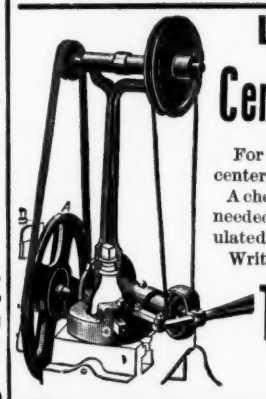


D. SAUNDERS' SONS,
Manufacturers of
Pipe Cutting & Threading Machines
For Pipe, Mill and Steam Fitters' Use.
TAPPING MACHINES,
For Steam Fitting, also
Steam and Gas Fitters' Hand Tools.
SEND FOR CIRCULAR.
YONKERS, N. Y.



Blaisdell Engine Lathes.
All Sizes from 14 in. to 30 in. swing carried in stock.
HILL, CLARKE & CO.,
156 OLIVER ST., BOSTON, MASS.

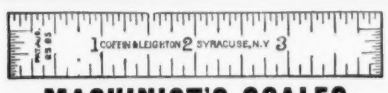
BOYNTON & PLUMMER,
WORCESTER, MASS.
Manufacturers of
Shaping Machines, Drilling Machines, Bolt Cutting Machines.
Send for Catalogue.



LATHE Center Grinder
For trueing **hardened** centers **in place.**
A cheap and effective tool, needed in every well-regulated machine shop.
Write for prices to
TRUMP BROS. MACH. CO.
WILMINGTON, DEL.

THE BARNES WATER EMERY TOOL GRINDER.

It has no pumps. No valves. No piping to supply it with water. It has nothing to get out of order, is always ready for use. It is as easily managed as a grindstone and will give vastly better results.
Sold subject to approval. Send for full description and price.
W. F. & John Barnes Co., Rockford, Ill..
Address No. 1995 Ruby Street.



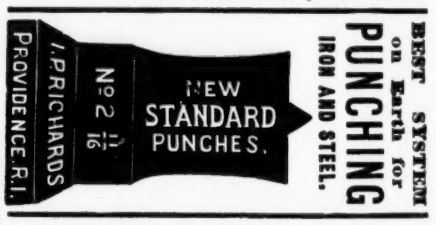
MACHINIST'S SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

EAGLE ANVIL WORKS,
Trenton, N. J.

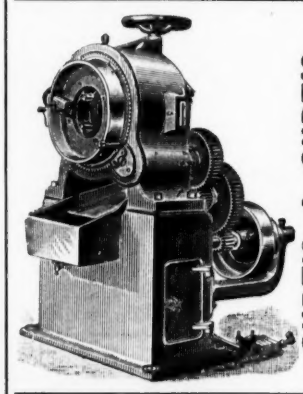
The Fisher Double Screw Leg Vise.—Warranted stronger grip than any other Vise. Always parallel and cannot be broken.
Send for Circulars.

The Eagle Anvil.—Best Cast Steel Face & Steel Horn. Better than any English anvil. Fully warranted and lower price.

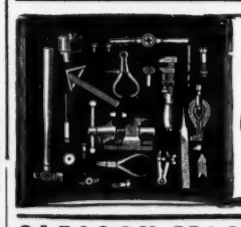
These Hack Saws will cut Iron and Steel beyond all expectation.
Iron working mechanics everywhere must and will use them. They do the work of files at one-tenth the cost, and in one-tenth the time. One Patent Nickel-plated Steel frame, and one dozen 8 inch Blades, sent by mail, prepaid, on receipt of $1.50. Hardware dealers will furnish them at at the same price. All saws marked with a star, and bearing our name are fully warranted.
MILLERS FALLS CO.,
93 Reade Street, New York



WILLIAM BARKER & CO.,
Manufacturers of
Iron and Brass Working
MACHINERY,
140 & 142 E. SIXTH ST.,
Near Culvert,
CINCINNATI, O.
Send for Circulars and Prices.



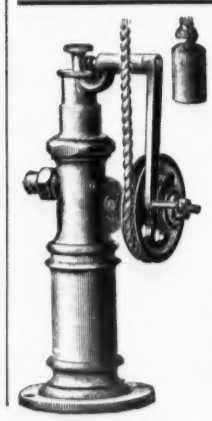
CURTIS & CURTIS,
66 CARDEN ST., BRIDGEPORT, CONN.
Pipe Cutting and Threading Machinery,
FOR HAND OR POWER.
RATCHET DRILLS, RATCHET DIE STOCKS AND MALLEABLE IRON PIPE VISES



EVERYTHING FOR **MACHINISTS** in any quantity.
Chandler & Farquhar,
BOSTON, MASS.
Send for Catalogue.

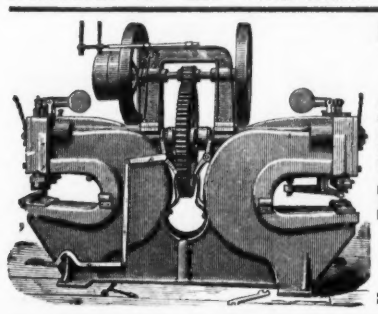
GLEASON MACHINE TOOLS
Engine Lathes, 22 inch to 72 inch swing.
Iron Planers, 26 inch to 84 inch wide.
HILL, CLARKE & CO.,
156 OLIVER ST., BOSTON.

STEVENS PATENT SPRING INSIDE CALIPERS
Leader, No. 72.
Price, by mail, postpaid.
4 inch.....$0.75 | 5 inch.....$0.80 | 6 inch.....$0.85
These goods excel, for neatness and fine finish, any other make. Ideal and Leader Spring Dividers and Calipers, Ideal Surface Gauges, Depth Gauges, and Fine Machinists' Tools.
Illustrated catalogue free to all.
J. STEVENS ARMS & TOOL CO.,
P. O. Box 231, Chicopee Falls, Mass.

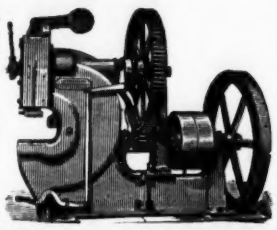


Damper Regulators.
Ours is the Simplest, Cheapest and Best.
Price, $60 and $100.
Each Machine Nickel Plated.
Only Two Connections Necessary.
Weight 15 and 30 lbs.
Mason Regulator Co.,
BOSTON.

WILLIAM SELLERS & CO., Incorporated.
PHILADELPHIA, PA.
BUILDERS OF
MACHINE TOOLS FOR WORKING IRON AND STEEL
Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES.
High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.
INJECTORS for ALL CONDITIONS of LOCOMOTIVE and STATIONARY SERVICE.

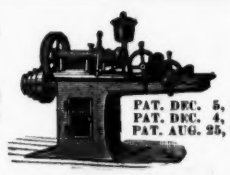


THE LONG & ALLSTATTER CO. Hamilton OHIO.
Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven
Punches and Shears,
OVER 300 SIZES.
ALSO
Power Cushioned Hammer.
Send for New Catalogue.

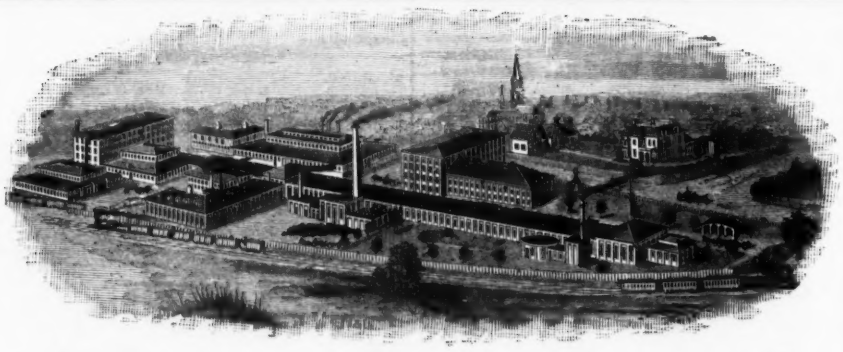


OPEN SIDE IRON PLANERS FOR IMMEDIATE DELIVERY.
One 30 in.x25 in.x6 ft.
One 30 in.x25 in.x6 ft. with Extra Side Head.
Two 30 in.x25 in.x8 ft.
One 36 in.x30 in.x8 ft.
One 48 in.x48 in.x14 ft. with Extra Side Head.
One 48 in.x48 in.x16 ft. with Extra Side Head.
THE DETRICK & HARVEY MACHINE CO.,
BALTIMORE, MD.

ACME MACHINERY CO.
CLEVELAND, OHIO.
Manufacturers of
ACME BOLT & RIVET HEADERS,
Acme Single & Double Automatic BOLTCUTTERS.
Cutting from 1-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
FIRST PREMIUM, CINCINNATI CENTENNIAL.



PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.



The Corliss Steam Engine Co.
PROVIDENCE, R.I.
Incorporated June, 1856; Established by
GEORGE H. CORLISS,
INVENTOR OF THE CELEBRATED
"CORLISS ENGINE."
DESIGNER & BUILDER OF THE FAMOUS
"CENTENNIAL ENGINE,"
Exhibited at the Philadelphia Exposition, 1876.

These works have been fully equipped, at great cost, with heavy special tools, of his invention, for the manufacture of this perfected engine, which is a guarantee of superiority in workmanship, and interchangeability of parts never before attempted in the line of steam machinery.

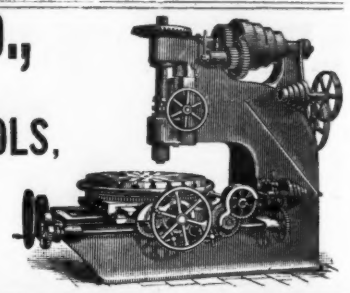
The public will understand that we have no relations with American or European builders of so-called "Improved Corliss Engines," and that the final and perfected Engine of Mr. George H. Corliss, embodying his latest ideas, is to be obtained, in America, exclusively at our works.

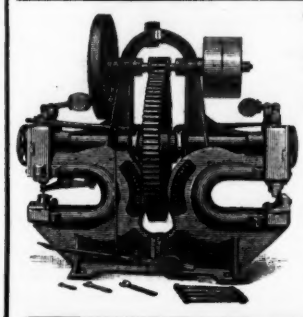
ALSO MANUFACTURERS OF THE

CORLISS PATENT VERTICAL TUBULAR WATER LEG BOILER,

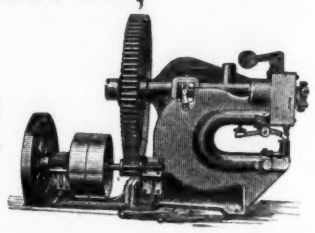
Especially adapted for compound and triple expansion engines requiring superheated steam and at very high pressure.

BEMENT, MILES & CO.,
PHILADELPHIA, PA.,
BUILDERS OF
METAL-WORKING MACHINE TOOLS,
FOR
RAILROAD SHOPS,
LOCOMOTIVE AND CAR BUILDERS,
MACHINE SHOPS, ROLLING MILLS,
STEAM FORGES, SHIP YARDS,
BOILER SHOPS, BRIDGE WORKS, ETC.



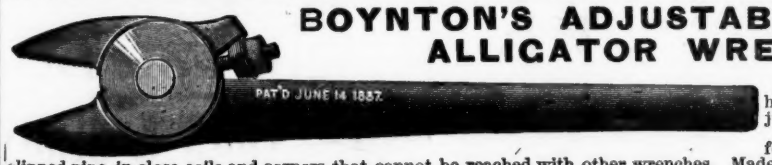


The HILLES & JONES CO., WILMINGTON, DEL.
MANUFACTURERS OF
PUNCHES AND SHEARS,
All Designs and Sizes,
AND A FULL LINE OF
MACHINE TOOLS
FOR
Boiler Makers, Bridge Builders, Ship Builders, Railroad Shops, Locomotive and Car Builders, etc., etc.



THE AERATED FUEL COMPANY,
425 MAIN STREET, SPRINGFIELD, MASS. J. H. BULLARD, MANAGER.
FORGING AND WELDING BY PETROLEUM AIR BLAST.
ALL OIL BELOW BURNERS! NO SMOKE, DIRT OR ASHES!
Represented by WILLIAM PICKETT, SON & CO., 170 Lake St., Chicago. W. S. COLLINS, Temple Court, 7 Beekman Street, Rooms 814-816, New York. CHILON JONES, Gananoque, Can. G. M. SMITH, Los Angeles, Cal. C. S. BARROWS, 46 Wade Building, Cleveland, Ohio, Michigan and Indiana. GILBERT & BARKER MFG. CO., General Agents for the United States, Springfield, New York and Boston. THOMAS, SHEPARD & SEARING, Arapahoe Building, Denver, Col. Sept. 29, 1885 July 5, 1887 Feb. 5, 1889 July 23, 1889
☞ We will replace in Stock or Mutual Companies any Insurance canceled on account of using this System, when installed according to our plans.

BOYNTON'S ADJUSTABLE ALLIGATOR WRENCH.

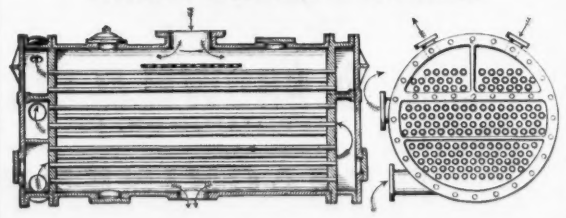


Quick and handy in adjustment. Invaluable for work on clipped pipe, in close coils and corners that cannot be reached with other wrenches. Made entirely of drop forged steel. *Four sizes.*
CAMPBELL PRINTING PRESS AND MFG. CO., MFRS.
160 WILLIAM ST., NEW YORK. 325 DEARBORN ST., CHICAGO.

Our Location, Foundry Capacity and Machine and Pattern Shop Equipment afford us **special facilities for furnishing HEAVY CASTINGS TO ORDER,** in any quantity up to size 20,000 lbs., or SMALL CASTINGS where large quantities are required. Get our estimates and prices before ordering.
ALLENTOWN FOUNDRY & MACHINE CO.,
3d and Walnut Streets, ALLENTOWN, PA.

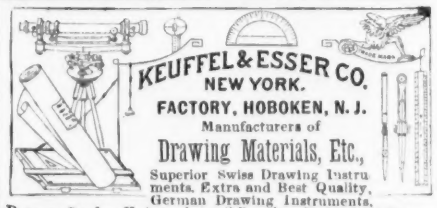
WYMAN & GORDON,
WORCESTER, MASS.
DROP FORGINGS.

SOUTH BROOKLYN STEAM ENGINE WORKS,
Successors to WILLIAM A. LIGHTHALL.
VAN BRUNT AND SUMMIT STS., BROOKLYN, N. Y.
New York Office, 69 Wall St.
BUILDERS OF THE
Pat. Combined Surface Condenser and Feed Water Heater.



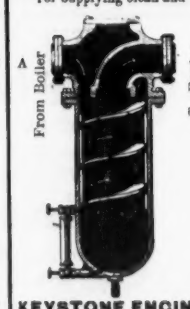
Lighthall Surface Condensers with Cobb's Improvements. Light Weight Brass Condensers a Specialty. Also Feed Water Heaters, Tube Heads, Screw Glands, Packings, &c.

L. S. STARRETT,
Manufacturer of
FINE TOOLS,
ATHOL, MASS.
SEND STAMP FOR FULL LIST.



KEUFFEL & ESSER CO.
NEW YORK.
FACTORY, HOBOKEN, N. J.
Manufacturers of
Drawing Materials, Etc.,
Superior Swiss Drawing Instruments. Extra and Best Quality, German Drawing Instruments, Paragon, Duplex, Universal, Anvil Drawing, Helios, Blue Process Papers, Scales, Triangles, T-Squares, Drawing Boards, Standard Profile and Cross-section Papers.
Catalogue to professional people on application.

SIMPSON'S CENTRIFUGAL SEPARATOR,
For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.



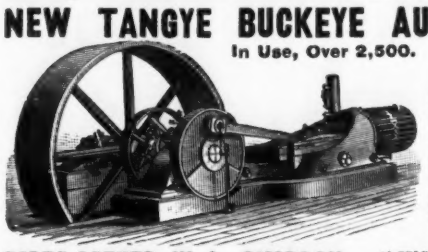
Simpson's Centrifugal Separator and Trap.
For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.
Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or top, as convenience may require; also used in conveying steam long distances, for Steam Hammers and Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.
KEYSTONE ENGINE AND MACHINE WORKS
Fifth and Buttonwood Streets, Philadelphia,
Or, A. T. ARTHUR, Selling Agent, 18 Cortlandt St., N. Y.

CHEAPEST AND BEST
THE WATER-TUBE FEED-WATER HEATER

SEND FOR CATALOGUE
THE GOUBERT MFG. CO.
32 CORTLANDT ST. NEW YORK

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES

In Use, Over 2,500. 25 to 1,000 H. P.



These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for Driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

SALES AGENTS: W. L. SIMPSON, 10 TELEPHONE BUILDING, 18 CORTLANDT STREET, N. Y. N. W. ROBINSON, 154 Washington St., Chicago, Ill. ROBINSON & CARY COMPANY, St. Paul, Minn.

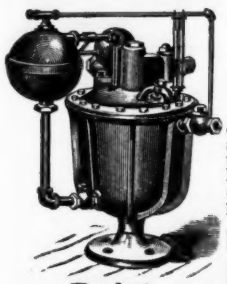
KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland, and Virginia.

THE ALBANY STEAM TRAP CO.'S

BUCKET AND GRAVITATING

TRAPS.



Bucket.

Automatically drain the water of condensation from **HEATING COILS** and return it to the boilers whether the coils are **above** or **below** the water level in boiler, doing away with pumps and other mechanical devices for such purposes.

We also manufacture **Blessing's Patent Renewable Seat Stop and Check Valves.**—Send for Circular.

Albany Steam Trap Co., Albany, N. Y.

Gravitating.

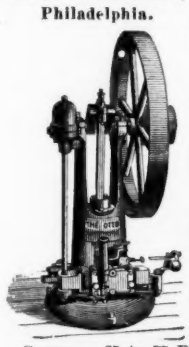
"OTTO" GAS ENGINE WORKS.

SCHLEICHER, SCHUMM & CO.,

33d & Walnut Streets, Philadelphia. 151 Monroe Street, Chicago.

New York Agency, 18 Vesey St.

35,000 SOLD.



Many New Improvements FOR USE WITH

COAL GAS, NATURAL GAS, PRODUCER GAS, OR GASOLINE

COMBINED

"OTTO" GAS ENGINES AND PUMPS.

Consume 25 to 75 Per Cent. Less Gas than ANY other Gas Engine doing the same work.

BRAINARD GEAR CUTTING MACHINES.

18 In., 24 In., 36 In., 48 In.

HILL, CLARKE & CO.,

General Selling Agents,

156 OLIVER ST., BOSTON, MASS.

MACHINE TOOLS

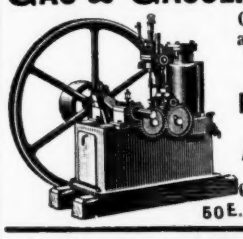
ENGINE LATHES,
BRASS LATHES,
BORING AND TURNING MILLS,
SCREW MACHINES,

on hand and in process of construction.

BRIDGEPORT MACHINE TOOL WORKS,

E. P. BULLARD, PROPRIETOR. BRIDGEPORT, CONN.

VAN DUZEN GAS & GASOLINE ENGINE



OPERATED with COAL and OTHER MANUFACTURED GASES AND GASOLINE.

RELIABLE AND ECONOMICAL.

Fully Warranted

VAN DUZEN Gas & Gasoline Engine Co. 50 E. 2d St., Cincinnati, O.

Something New! One, two, three, and four spindle drills for light work.

DRILLS

The most useful patented improvement in drill presses for years is applied.

SENSITIVE

Spindles driven with single, endless belts. Large driving pulleys, tightener and variable speeds provided.

Over 1,000 in use. Buy the **latest** and **best.** Special machinery to order. Catalogue of fine tools free.

Dwight Slate Machine Co.

HARTFORD, CONN.

MACHINE TOOLS

FOR IMMEDIATE DELIVERY.

One Driving Wheel Lathe 70" swing; second-hand.
One Fitchburg Engine Lathe 24" by 16'; new.
One Lathe and Morse Lathe 32" by 17'; new.
One Lathe and Morse Lathe 36" by 15'; new.
One Gray Planer 30" x 30" x 8'; new.
One Pease Planer 34" x 32" x 8'; new.
One Pease Planer 36" x 36" x 8'; special; new.
One Powell Planer 30" x 30" x 10'; new.
One Pond Planer 38" x 38" x 12' with 2 heads; new.
One Powell Planer 48" x 48" x 14' with 2 heads; new.
One No. 4 Brainard Milling Machine.
One Detrick and Harvey Open Side Planer, size C, with supplemental rolling table and extra saddle on post.

Send for complete List of New and Second hand Tools.

HILL, CLARKE & CO.,

156 Oliver Street, *Boston, Mass.*

NEW AND SECOND HAND

MACHINERY

FOR IMMEDIATE DELIVERY.

The following second hand Tools we have replaced with our **IMPROVED NEW ONES** and will close them out low.

Putnam,	Engine Lathe,	13 in. swing,	4 1-2 ft. Bed
New Haven,	" "	16 in. "	6-8 ft. "
Lathe & Morse,	" "	16 in. "	6 ft. "
Fitchburg,	" "	16 in. "	8 ft. "
Ferris & Miles,	" "	17 in. "	8 ft. "
New Haven,	" "	18 in. "	8 ft. "
Wood & Light,	" "	20 in. "	7 1-2 ft. "
Townsend	" "	21 in. "	7 ft. "
Fifield	" "	22 in. "	14 ft. "
New Haven,	" "	25 in. "	10 ft. "
Heavy pattern,	" "	25 in. "	15 ft. "
Heavy pattern,	" "	25 in. "	21 ft. "
Leonard,	" "	38 in "	18 ft. "

Am. Tool Co., No. 2 Cabinet Turret Lathe.
Gage, Square Arbor Fox Lathe, 15x5.

Badger,	Planer,	24 in.x 6 ft.
New Haven,	"	24 in.x 7 ft.
Pond,	"	26 in.x 8 ft.
New Haven,	"	30 in.x 8 ft.
New Haven,	"	32 in.x10 ft.

Old Style, Shaper Crank, 12 in. stroke.
Lincoln Pattern Milling Machine.
Brown & Sharpe, No. 2 Screw Machine.
Jones & Lamson, No. 4 do. wire feed.
Brown & Sharpe, 18 in. Automatic Gear Cutter.
Upright Boring and Turning Mill, 39 in. New.

NEW TOOLS

On Hand and Early Deliveries.

Fitchburg Machine Works, Lathes and Planers.
Prentice Bros., Lathes, 14-16-18 in.
Hendey Machine Co., Lathes, 16x6.
Lathe & Morse, Lathes, 21-27-32 in.
Wright Machine Works, Lathes, 16-20-24 in.
Fay & Scott, Lathes, 28-32 in.
McMahon, Lathes, 16 20 in.
Prentice Bros. Drills, 20-21-25-28-32 in.
Powell Planer Co., Planers, 22-24-30-36 in.
Gould & Eberhardt, Shapers, 16 24 in.

Large Assortment of other Tools, New and Second Hand. Send for Complete List.

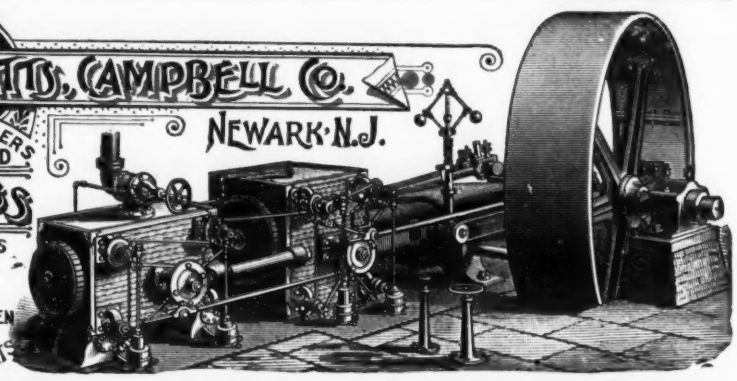
68 Cortlandt St., NEW YORK. | **J. J. McCABE** Successor to **E. P. BULLARD'S** New York Machinery Warerooms.

THE WATTS, CAMPBELL CO.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

NEWARK, N.J.

CONTRACTS TAKEN FOR COMPLETE POWER PLANTS



Eclipse Corliss Engine.

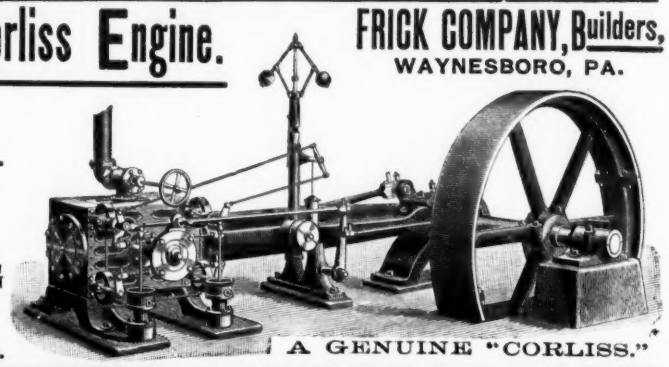
FRICK COMPANY, Builders,
WAYNESBORO, PA.

NON-CONDENSING,
CONDENSING COMPOUND.
40 TO 1,000 H.P.

Send for Circulars.

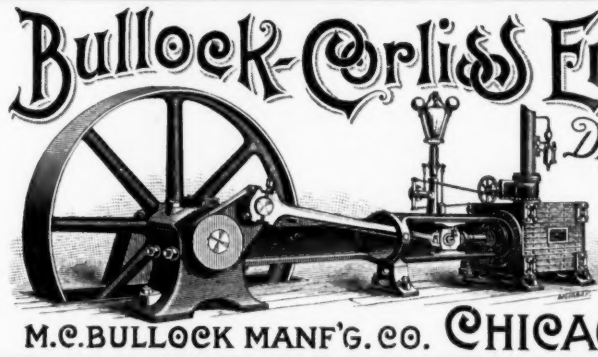
ICE-MAKING AND REFRIGERATING MACHINERY.

Send for Special Circular.



A GENUINE "CORLISS."

Bullock-Corliss Engines.



DIAMOND DRILLS —FOR— PROSPECTING.

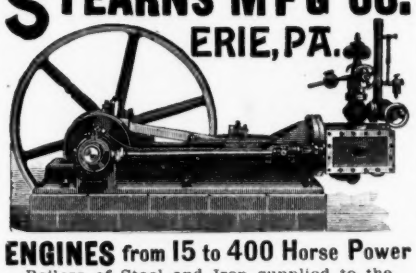
BAND FRICTION HOISTS.

MINING MACHINERY.

M.C. BULLOCK MANF'G. CO. CHICAGO, U.S.A.

STEARNS M'F'G CO.

ERIE, PA.



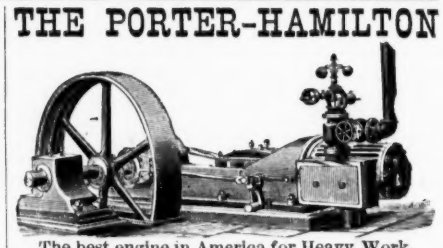
ENGINES from 15 to 400 Horse Power

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.

SAW MILLS AND GENERAL MACHINERY

NEW YORK STORE, 46 Cortlandt St.

THE PORTER-HAMILTON



The best engine in America for Heavy Work.

WILLIAM TOD & CO.,
Youngstown, Ohio.

OUR NEW **CATALOGUE OF TOOLS**

And Supplies sent free to any address on receipt of Ten Cents in Stamps (for postage).

Chas. A. Strelinger & Co., WOOD AV. **Detroit, Mich**

STEAM HEATING.

Barnard's Condensing System will accomplish the following desirable features:

Saves Coal, Perfects the Circulation, Prevents all Noise, Prevents Freezing, Uses Exhaust Steam if any, without back pressure, will work at any pressure of steam, high or low. Has no Machinery needing care. Is adapted to Private Houses, Flats, Office Buildings, Hotels, Factories, etc.

GEO. A. BARNARD,

No. 15 Cortlandt St., NEW YORK.

"Prices are low yet quality tells."

A Corliss Engine

well designed and thoroughly built, is the best the world today possesses.

The Lane & Bodley Co., Cincinnati, O., have a high ideal of what their engines should be, and invite their customers to say what they are. If you want an engine and never have seen one of these, write for descriptive circular.

THE LANE & BODLEY CO.,
CINCINNATI, O.

CROWELL'S POSITIVE PRESSURE BLOWER,

FOR

Blast and Smelting Furnaces, Forges, Cupolas or any Pneumatic Service where a positive pressure or Vacuum is desired. Any pressure from 1 to 10 lbs. can be obtained, and maintained. Slow running. Minimum of power required.

MANUFACTURED BY

HONESDALE IRON WORKS,
HONESDALE, PA.

HUGO BILGRAM,

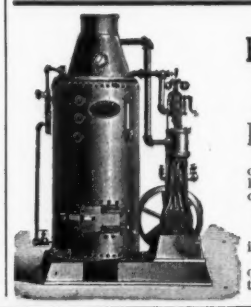
440 N. 12th St., Phila., Pa.

Maker of all kinds of

MACHINERY.

Special facilities for Accurate Work.

Bevel Gears cut theoretically Correct.



LANE'S

Foundry & Machine WORKS,
HUNTINGDON, PA.

Fine Upright Engines.

The following sizes are carried in stock, made in large quantities, with special tools, at special prices:

3, 4, 5, 6, 7 & 9 H. P.

If you want one Engine, it will pay you to write us. If you handle large quantities, it will pay you to write us.

BALL AUTOMATIC ENGINES.

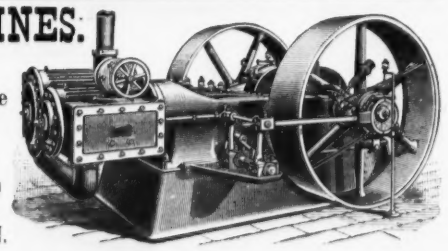
WORKS: ERIE, PA.

High-Pressure, Compound and Triple Expansion, Condensing and Non-Condensing.

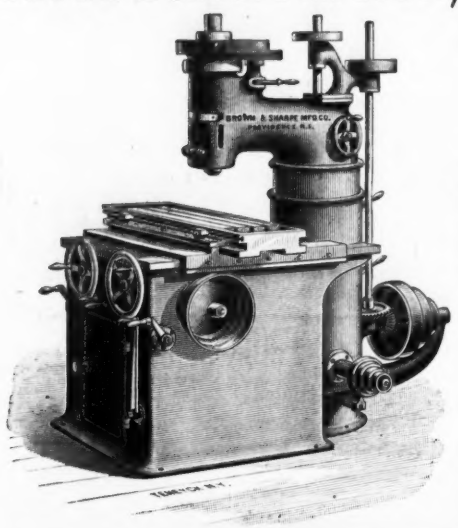
CHARLES R. VINCENT & CO.,

Contracting Engineers,

15 Cortlandt St., NEW YORK. 38 Oliver St., BOSTON.



BROWN & SHARPE MFG. CO., Providence, R. I., U. S. A.



No. 2 VERTICAL SPINDLE MILLING MACHINE.

This machine, for many kinds of work, is preferable to a machine with a horizontal spindle. The operator can more clearly and easily see the work and more readily follow any irregularity in the outline of the surface to be milled.

The Platen is gibbed solidly to a broad and substantial base and rests upon flat and ample bearings. It is 41 inches long and 13 3-4 inches wide and is fed in either direction automatically or by hand. It has eight changes of speed for each speed of spindle.

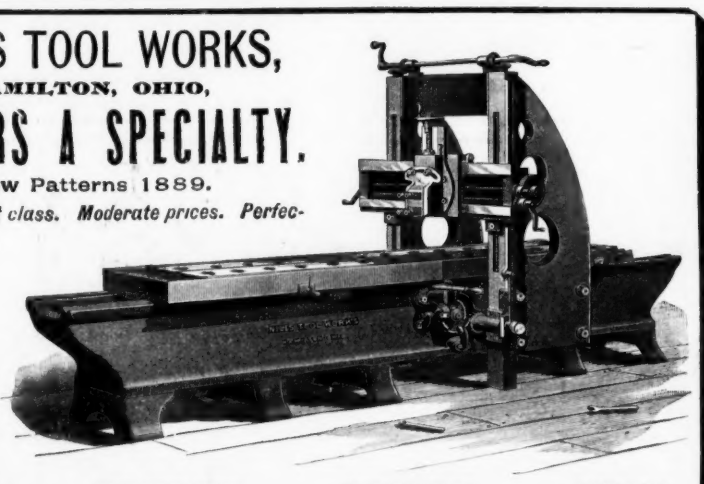
The spindle has three belt and three gear speeds, which, with two speeds of counter, make twelve speeds in all. At its lowest position the spindle is 1 1-2 inches and at its highest 15 inches above the platen. Cutters up to 8 inches diameter may be used in surfacing.

Weight, 5,100 pounds. Floor Space, 82x78 inches.

S. A. SMITH,
Western Representative,
23 South Canal Street,
CHICAGO, ILL.

NILES TOOL WORKS,
HAMILTON, OHIO,
PLANERS A SPECIALTY.
New Patterns 1889.

Strictly first class. Moderate prices. Perfection of workmanship. Positive feed. Quick return. Extra heavy. Large bearings. The smoothest running Planers.



NEW YORK, 98 Liberty St. PHILADELPHIA, 705 Arch St. PITTSBURGH, Lewis Block. CHICAGO, Phenix Building.

CRANES
THE YALE & TOWNE MFG CO.
STAMFORD CONN
NEW YORK CHICAGO PHILA BOSTON

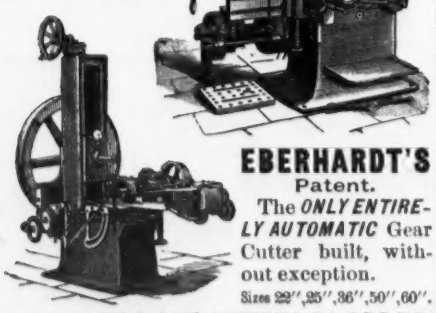
JENKINS BROS.' VALVES.
JENKINS every valve tested and warranted, all parts interchangeable.
Nothing but best Steam Metal used in the manufacture
Eyed Stuffing Box and Disc Removing Lock Nut
Is used only in the Jenkins Bros.' Valves.
None are genuine unless stamped with "Trade Mark."
Should you order INSIST on having Jenkins Bros.' Valves.
71 JOHN STREET, NEW YORK. 54 DEARBORN STREET, CHICAGO.
21 NORTH FIFTH STREET, PHILA. 105 MILK STREET, BOSTON.

ENGINE LATHES. PULLEY LATHES.
MONITOR AND FOX LATHES.
TURRET BORING LATHES.
EXTRA HEAVY IRON PLANERS.
TRIPLE GEARED AND CRANK SHAPERS.
UPRIGHT DRILLS WITH SPECIAL FEATURES.
IMPROVED MILLING MACHINES.

☞ MACHINE SHOP OUTFITS A SPECIALTY.

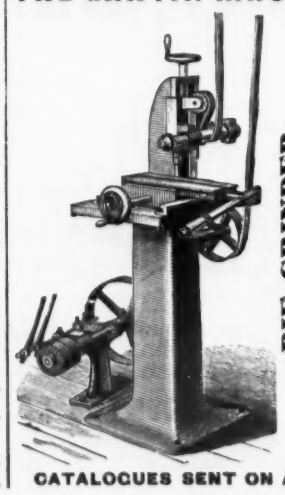
THE LODGE & DAVIS MACHINE TOOL CO.,
WORKS: CINCINNATI, O.
EASTERN HOUSE, 64 CORTLANDT ST., NEW YORK.
WESTERN HOUSE, 68 & 70 S. CANAL ST., CHICAGO.
☞ *SEE ADVERTISEMENT, PAGE 16.*

GOULD & EBERHARDT.
Near Market St. Depot,
NEWARK, N. J.
Pat. Shapers.
NEARLY 1,500 IN USE.
Sizes 12″,16″,24″,26″,30″.



EBERHARDT'S Patent.
The *ONLY ENTIRELY AUTOMATIC* Gear Cutter built, without exception.
Sizes 22″,25″,36″,50″,60″.
GEAR AND RACK CUTTING TO ORDER.

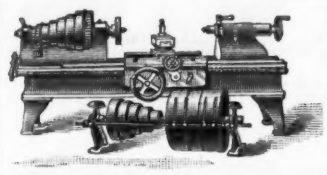
THE GARVIN MACHINE CO.



DIE GRINDER.
This is a very desirable and handy tool, designed particularly for use in connection with punch presses for grinding and sharpening dies, punches, etc.

Manufacturers and Dealers in MILLING MACHINES, SCREW MACHINES, AUTOMATIC TAPPERS, LATHES, PLANERS, TAPPERS, DRILLS, &c.,
LAIGHT AND CANAL STS., N. Y. CITY.
CATALOGUES SENT ON APPLICATION.

THE PRATT & WHITNEY CO.,
HARTFORD, CONN.



Manufacture **LATHES** of Various Sizes
AND OF THE FOLLOWING KINDS:
Hand, Engine for Turning and Screw Cutting, Cutting Off, Gap Bed, Pulley Turning and Boring, Turret-Head Engine and Chucking, Hand Wheel Rim Turning, Spinning, Grinding, Pattern Making, &c.

☞ PRICE LIST AND DISCOUNT SHEET SENT UPON APPLICATION.
WESTERN BRANCH, 100 West Washington Street, Chicago, Ills.

THE BILLINGS & SPENCER CO.,
HARTFORD, CONN., U. S. A.,
MANUFACTURERS OF
BILLINGS' PATENT SURFACE GAUGE.

This Surface Gauge is drop forged, of bar steel, and finished in a thorough manner, and hardened.

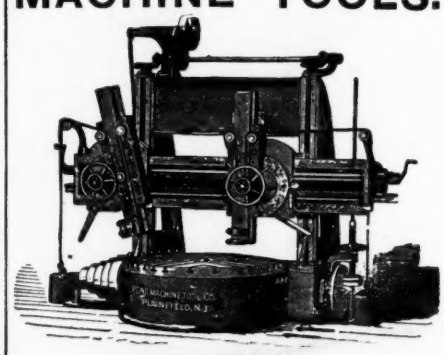
Send for Illustrated Catalogue and Price List of Machinists' Tools.

DROP FORGINGS OF BRONZE, COPPER, IRON AND STEEL
OF EVERY DESCRIPTION.

WARNER & SWASEY,
MACHINE TOOLS CLEVELAND, OHIO.

For IRON and BRASS WORK.
Illustrated Catalogue on application.

THE POND MACHINE TOOL CO.,
Formerly of Worcester, Mass.
MANUFACTURERS OF
MACHINE TOOLS.



BORING MILLS.
Radial Drills, Planers, Lathes, Heavy & Powerful, from new patterns of the latest and best designs.
SALESROOM & OFFICE, 113 Liberty St., N. Y. City.
NEW SHOPS, PLAINFIELD, N. J.

GEO. W. FIFIELD,

Manufacturer of ENGINE LATHES from 16 to 48 in. swing. Cuts, Photographs and Prices furnished on application.
Lowell, Mass., U. S. A.

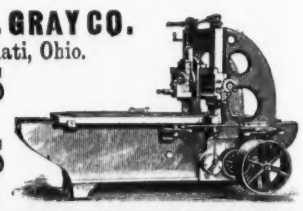
Every machine or manufacturing concern should send for the list of 600 sizes of cut iron spur and bevel gear wheels and racks lately issued by the Lexington Gear Works, of Lexington, Mass.
(GRANT)

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

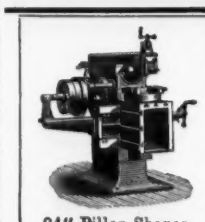
HARTFORD, CONN.
J. M. ALLEN, PRESIDENT.
WM. B. FRANKLIN, VICE-PRESIDENT.
F. B. ALLEN, SECOND VICE-PRESIDENT.
J. B. PIERCE, SECRETARY & TREASURER.

Key-Seating Machines and 20 in. Drills
A SPECIALTY.
SEND FOR LIST OF
New and Second-Hand
Lathes, Planers, Drills, or anything in Machinists' Tools or Supplies.
W. P. DAVIS,
Rochester, N. Y.
Works at North Bloomfield.

THE G. A. GRAY CO.
Cincinnati, Ohio.
PLANERS AND LATHES
A SPECIALTY.



STEEL CASTINGS.
PRATT & LETCHWORTH,
PROPRIETORS
BUFFALO STEEL FOUNDRY,
BUFFALO, N. Y.



24″ Pillar Shaper.

15″ Pillar Shaper.

25″ Pillar Shaper.

THE HENDEY MACHINE CO.
TORRINGTON, CONN.
MANUFACTURERS OF
MACHINE TOOLS
SEND FOR OUR CATALOGUE.

J.M.CARPENTER PAWTUCKET.R.I.

Manufacturer —of— TAPS & DIES